

ULTRA-CURVE®

Digital Dual-DSP Mainframe

Model DSP 8000

VERSION 1.3 July 1996

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SAFETY INSTRUCTIONS

CAUTION: To reduce the risk of electrical shock, do not remove the cover (or back). No user serviceable parts inside: refer servicing to qualified personnel.



WARNING: To reduce the risk of fire or electrical shock, do not expose this appliance to rain or moisture.



This symbol, wherever it appears, alerts you to the presence of uninsulated dangerous voltage inside the enclosure - voltage that may be sufficient to constitute a risk of shock.



This symbol, wherever it appears, alerts you to important operating and maintenance instructions in the accompanying literature. Read the manual.

DETAILED SAFETY INSTRUCTIONS:

All the safety and operation instructions should be read before the appliance is operated.

Retain Instructions:

The safety and operating instructions should be retained for future reference.

Heed Warnings:

All warnings on the appliance and in the operating instructions should be adhered to.

Follow Instructions:

All operation and user instructions should be followed.

Water and Moisture:

The appliance should not be used near water (e.g. near a bathtub, washbowl, kitchen sink, laundry tub, in a wet basement, or near a swimming pool etc.).

Ventilation:

The appliance should be situated so that its location or position does not interfere with its proper ventilation. For example, the appliance should not be situated on a bed, sofa rug, or similar surface that may block the ventilation openings, or placed in a built-in installation, such as a bookcase or cabinet that may impede the flow of air through the ventilation openings.

Heat:

The appliance should be situated away from heat sources such as radiators, heat registers, stoves, or other appliances (including amplifiers) that produce heat.

Power Source:

The appliance should be connected to a power supply only of the type described in the operating instructions or as marked on the appliance.

Grounding or Polarization:

Precautions should be taken so that the grounding or polarization means of an appliance is not defeated.

Power-Cord Protection:

Power supply cords should be routed so that they are not likely to be walked on or pinched by items placed upon or against them, paying particular attention to cords and plugs, convenience receptacles and the point where they exit from the appliance.

Cleaning: The appliance should be cleaned only as recommended by the manufacturer.

Non-use Periods:

The power cord of the appliance should be unplugged from the outlet when left unused for a long period of time.

Object and Liquid Entry:

Care should be taken so that objects do not fall and liquids are not spilled into the enclosure through openings.

Damage Requiring Service:

The appliance should be serviced by qualified service personnel when:

- The power supply cord or the plug has been damaged; or
- Objects have fallen, or liquid has been spilled into the appliance; or
- The appliance has been exposed to rain; **or**
- The appliance does not appear to operate normally or exhibits a marked change in performance; or
- The appliance has been dropped, or the enclosure damaged.

Servicing:

The user should not attempt to service the appliance beyond that is described in the Operating Instructions. All other servicing should be referred to qualified service personnel.

WELCOME

Dear Customer,

Welcome to the Behringer ULTRA-CURVE and thank you for placing your trust in Behringer products. My most pleasant task is to write this letter to you, because it is the culmination of many months of hard work for our engineering team. We built in some extra features that will certainly compensate for the extra months it took. Our daily objective is to be focused on you, the musician and sound engineer, and with that focus in mind, it drives us to reach a goal which is unique, and is the backbone of the Behringer philosophy.

That philosophy is very simple, that you, the customer, are the most important part of the Behringer family. We will not accept anything less for you than the highest quality, best specified product, at the lowest price. This enables you to express your full creativity without price being a concern.

Due to the thousands of satisfied Behringer users around the world, we are able to demand the highest quality components industry can offer, at extremely low prices, making the final cost of our products astonishingly low. Why then, shouldn't we pass the benefit of our good fortune back to you, the musician and sound engineer? This enables you to own the type of quality equipment that previously would have cost very much more. It also allows you the confidence that your new equipment uses technology which is leading the way in the field of audio design.

I would like to thank the following people, whose help on Project ULTRA-CURVE' has made it all possible:

- * The existing users of Behringer equipment (whose comments and suggestions have made them the most important members of the Behringer design team),
- * Frieder, Ralf and Holger for the ingenious software (Why don't we build in a MIDI dishwasher? There's enough DSP power left!),
- * Hartmut and Stefan for the hardware (key-word 'PCB Revision #981'),
- * Frank for the fine mechanics (key-word 'Tooling Modification'),
- * Hubert for the unsurpassed manual,
- * Mark for the translation into (Irish) English,
- * Betty for the perfect layout
- * and all other helpers for their energetic assistance.

We believe a creative musician and sound engineer lies in you and we want to share in your success. Our products are built for people like you -people with a fine ear- and as you have trusted us by buying the Behringer ULTRA-CURVE, we return your trust by welcoming you into the Behringer family.

Thank you and sincerely yours,

A handwritten signature in black ink, appearing to read 'U. Behringer', with a long horizontal line extending to the right.

BEHRINGER Spezielle Studiotchnik GmbH

Uli Behringer

President

ULTRA-CURVE[®]

DIGITAL DUAL-DSP MAINFRAME MODEL DSP 8000

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1.0 INTRODUCTION

The Behringer ULTRA-CURVE is a fully digital sound processing device based on DSPs, and using 20-bit A/D and D/A converters. The high speed DSPs are capable of performing any process required of them in fractions of a second, the only element affecting their performance being the software. The enormous flexibility available means that the ULTRA-CURVE has a range of features greatly exceeding those found in a conventional analogue graphic equalizer, at a price previously unimaginable. The ULTRA-CURVEs features:

- ▲ Digital stereo Mainframe powered by two High-Speed Signal Processors
- ▲ Superb audio quality and dynamic range backed by high-grade 20-bit Converters with selectable Sampling Rate
- ▲ Open-ended architecture allows for future Software Upgrades
- ▲ Ultra-musical dual 31-band Graphic Equalizer with Auto-Q characteristics for "True Frequency Response"
- ▲ Shelving filters (low and high pass) with variable slope
- ▲ High-resolution Real Time Analyzer with peak hold, variable integration, cursor read-out and 10 user-memories
- ▲ Automatic Room Equalization using mic input and internal pink/white noise or sine wave generator
- ▲ Additional 6 bands of fully Parametric Equalizer / Notch Filter with up to 1/60th octave precision
- ▲ Integral fully automatic Feedback Destroyer with intelligent Signal Analyzer for ultra-fast Feedback Suppression
- ▲ Integral digital Multiband Limiter with variable Threshold control
- ▲ Integral digital Noise Gate with Behringer's unique IRC (Interactive Ratio Control)
- ▲ Integral Delay with up to 5 seconds delay time selectable in milliseconds, meter and feet (option)
- ▲ Ultra-accurate Level Peak Meter with Peak Hold and selectable Reference Levels (+4 dBu / -10 dBV / Dig Max)
- ▲ Full MIDI parameter and snapshot control (future EQ-design-software allows for total remote control via PC)
- ▲ 100 User-Memories can be stored under any alphanumeric name
- ▲ Memories backed by a long-life battery
- ▲ Security Key Password can be installed for user selective RTA- and EQ-memory protection and tamper-proof
- ▲ EQ- and Analyzer-curves may be copied, compared, added or subtracted
- ▲ Crossfade feature to fade between two settings and "StereoLink" facility to synchronize both channels
- ▲ AES/EBU Interface for Digital Inputs and Outputs (option)
- ▲ Large High-Resolution LCD Graphic Display with high-contrast LED-backlight
- ▲ Servo-balanced Inputs and Outputs with XLR- and jack connectors as standard
- ▲ Relay controlled Hard-Bypass with an Auto-Bypass function during power failure (failsafe relay)

1.1 SHORT INTRODUCTION TO DIGITAL SIGNAL PROCESSING

In order to convert an analogue signal - e.g. music - into a series of digital words, a so-called 'Analogue to Digital Converter' or ADC is used. The converter functions by viewing the signal entering it a given number of times over a period of time, e.g. 44,100 times per second, giving a rate of 44.1 kHz, and in each case measuring the signal amplitude, and giving it a numerical value. This form of measuring the signal regularly over a period of time is known as 'sampling', the conversion of the amplitude into a numerical value, quantizing. The two actions together are referred to as digitizing.

In order to carry out the opposite - the conversion of a digitized signal into its original analogue form - a 'Digital to Analogue Converter' or DAC is used. In both cases the frequency at which the device operates is called the sampling rate. The sampling rate determines the effective audio frequency range. The sampling rate must always be more than twice the value of the highest frequency to be reproduced. Therefore, the well known CD sampling rate of 44.1 kHz is slightly higher than twice the highest audible frequency of 20 kHz. The accuracy at which quantization takes place is primarily dependent on the quality of the ADCs and DACs being used.

The resolution, or size of digital word used (expressed in bits), determines the theoretical Signal/Noise ratio (S/N ratio) the audio system is capable of providing.

The number of bits may be compared to the number of decimal places used in a calculation – the greater the number of places, the more accurate the end result. Theoretically, each extra bit of resolution should result in the S/N ratio increasing by 6 dB. Unfortunately there are a considerable number of other factors to be taken into account, which hinder the achievement of these theoretical values.

If you picture an analogue signal as a sinusoidal curve, then the sampling procedure may be thought of as a grid superimposed on the curve. The higher the sampling rate (and the higher the number of bits), the finer the grid. The analogue signal traces a continuous curve, which very seldom coincides with the cross points of the grid. A signal level at the sampling points will still be assigned a digital value, usually the one closest to the exact representation. This limit to the resolution of the grid gives rise to errors, and these errors are the cause of quantizing noise. Unfortunately, quantizing noise has the characteristic of being much more noticeable and unpleasant to the ear than 'natural' analogue noise.

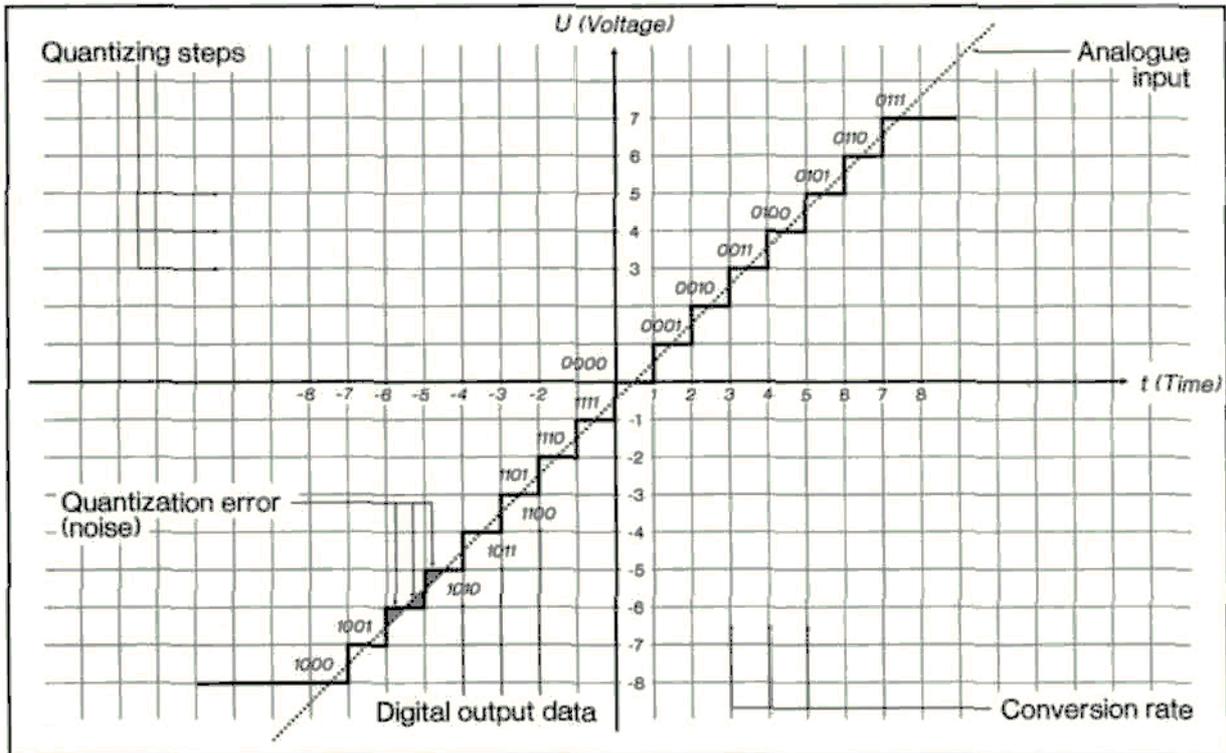


Fig. 1.1: Transfer diagram for an ideal linear ADC (2's complement representation)

In a digital signal processor, such as the DSPs in the ULTRA-CURVE, the data will be modified in a number of ways, in other words, various calculations, or processes, will be done in order to achieve the desired effect on the signal.

This gives rise to further errors, as these calculations are approximations, due to their being rounded off to a defined number of decimal places. This causes further noise. To minimize these rounding off errors, the calculations must be carried out with a higher resolution than that of the digital audio data being processed (as a comparison, an electronic calculator may operate internally with a greater number of decimal places than can be shown on its display). The DSPs in the ULTRA-CURVE operate with a 24 bit resolution. This is accurate enough to reduce quantizing noise to levels which are usually below the audible threshold. However, when using extreme equalizer settings, some quantizing side effects may be detected.

Digital sampling has one further, very disturbing effect: it is very sensitive to signal overload. Take the following simple example using a sine wave. If an analogue signal starts to overload, it results in the amplitude of the signal reaching a maximum level, and the peaks of the wave starting to get compressed, or flattened. The greater the proportion of the wave being flattened, the more harmonics, audible as distortion, will be heard. This is a gradual process, the level of distortion as a percentage of the total signal rising with the increase of the input signal level.

Digital distortion is quite different, as illustrated by this oversimplified example. If we take the situation where a 4 bit word has the positive maximum value of 0111, and add to it the smallest possible value of 0001 (in other words, the smallest increase in amplitude possible), the addition of the two results in 1000 - the value of the 'negative' maximum. The value is turned on its head, going instantly from positive max to negative max, resulting in the very noticeable onset of extreme signal distortion.

2.0 THE CONCEPT

The Behringer ULTRA-CURVE differs greatly from conventional graphic equalizers, in its filter concept, and resulting method of operation. Conventional graphic equalizers are, by the physical nature of their design, subject to strong interaction between adjacent filters, resulting in a difference between the frequency curve suggested by the fader position, and the real frequency curve achieved. This difference itself varies depending on the amount of frequency boost or attenuation applied. The same interaction occurs in digital filters, due to the finite filter slope used. However, digital control allows us to predict these interactions, and, by generating a compensating value for each affected filter, to compensate for them. The algorithm necessary to achieve this has been specially developed for the ULTRA-CURVE, making it a genuine "true response" equalizer.

The advantages of this are directly apparent. Formerly, you had to know exactly what effect a given equalizer setting on your graphic equalizer would really achieve. If you give the ULTRA-CURVE a particular setting, you can be sure that the resulting frequency curve will reflect the visual setting of the frequency filters. The ULTRA-CURVE takes the guesswork and indeed the 'witchcraft' out of equalizing.

The new control concept of the ULTRA-CURVE does, however, result in it having characteristics which need to be explained here.

Equalizer settings with extreme differences in levels between adjacent frequency bands require in some cases internal boosting and attenuation of up to 48 dB. Theoretically, this is quite possible, but can quickly lead to overloading and distortion of individual filters.

A traditional graphic equalizer tends to overload when several neighbouring filters are simultaneously boosted, since their combined effects will be summed, resulting in an overloading of the summed signal.

At first glance, the concept used in the ULTRA-CURVE may seem unusual. However, after using it you will realize that the "true response" concept allows you to use the ULTRA-CURVE intuitively, and that it is more straightforward to achieve the desired result. In order to set filter curves with very extreme slopes, the ULTRA-CURVE offers three extra, full parametric equalizers per channel, each having a wide range of settings.

To clearly illustrate the above principles in operation, we give you some examples. The settings shown here are unlikely to be ever used in practice, nevertheless they serve to illustrate the difference between the ULTRA-CURVE and a conventional graphic equalizer.

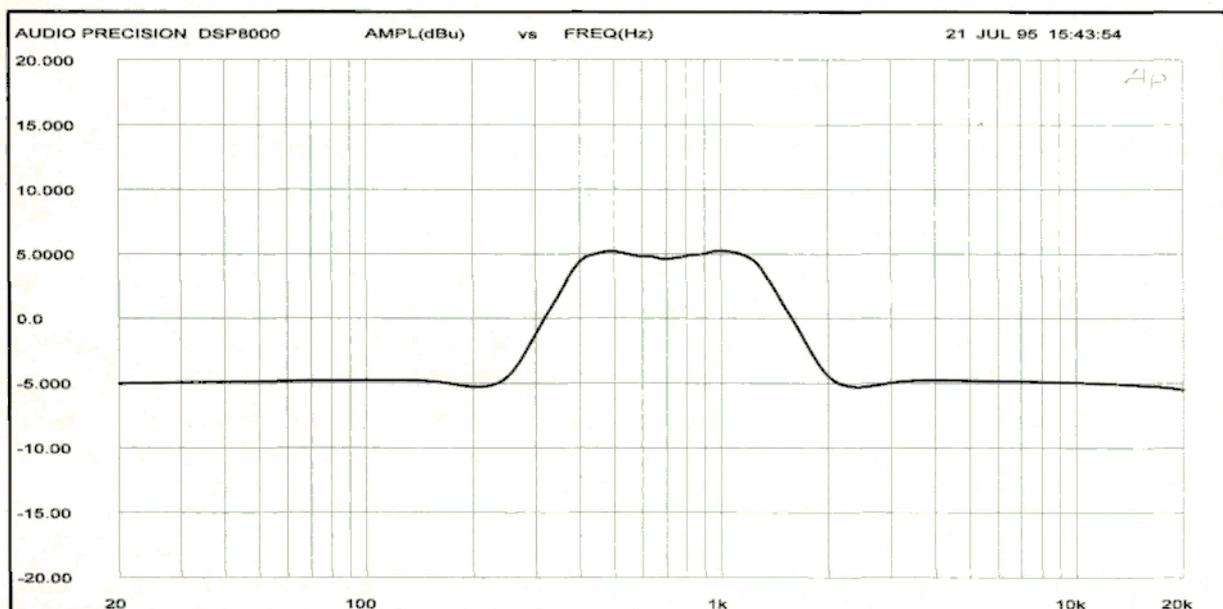


Fig. 2.1: ULTRA-CURVE with "true response"

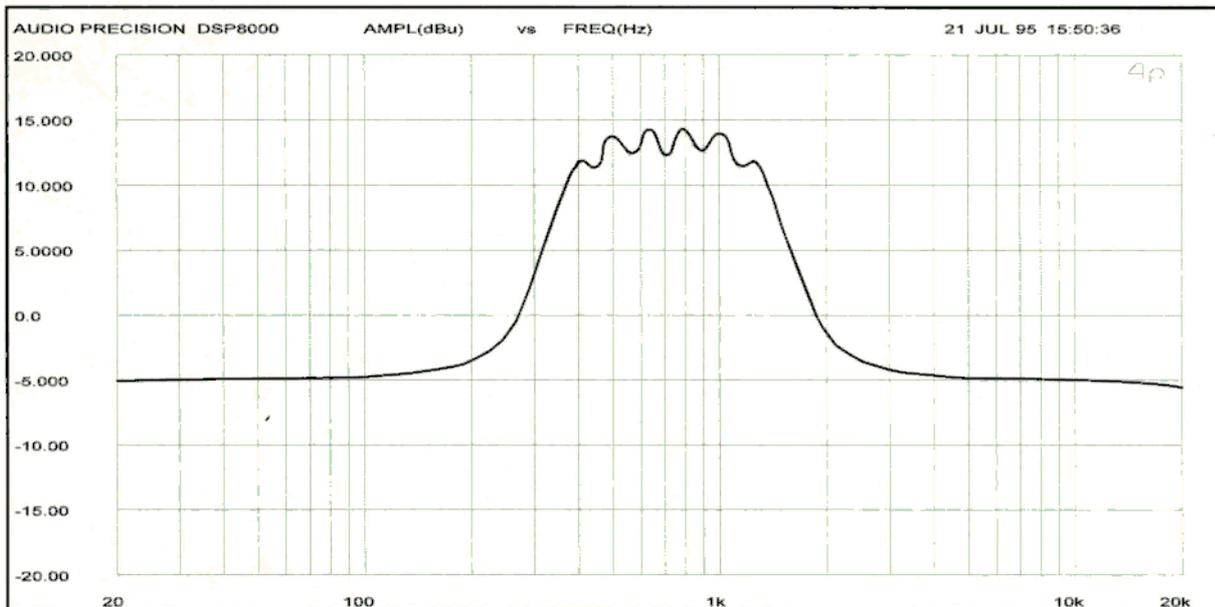


Fig. 2.2: Graphic equalizer with a fixed Q of 7

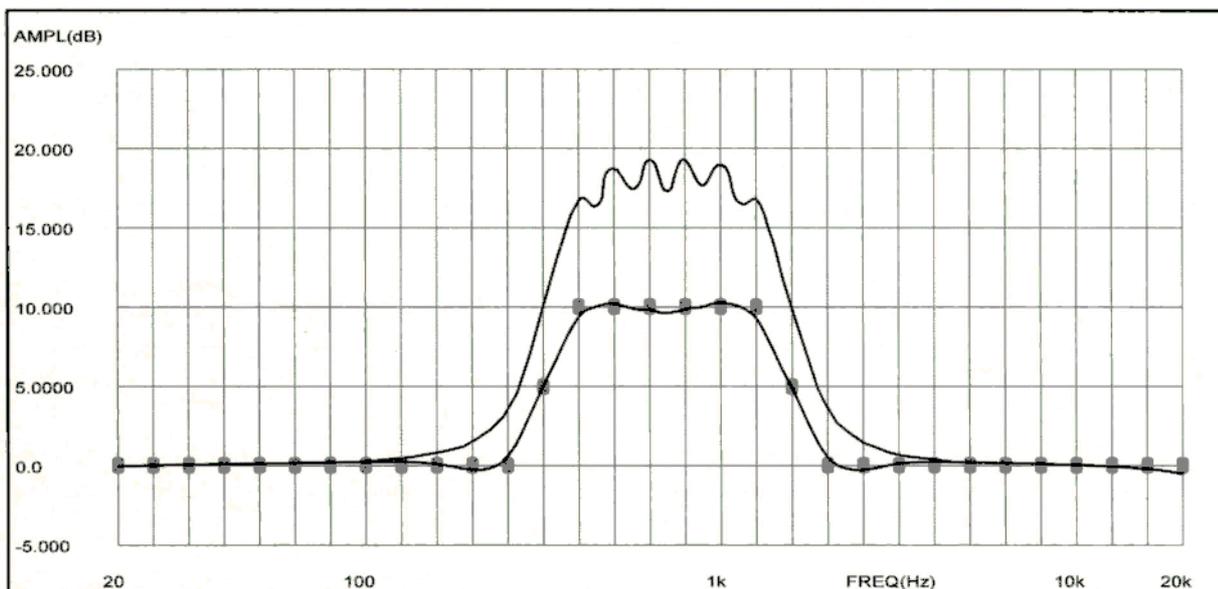


Fig. 2.3: Combination of 2.1 and 2.2, with the fader positions added

2.1 HIGH QUALITY COMPONENTS AND DESIGN

The philosophy behind Behringer products guarantees a no-compromise circuit design and employs the best choice of components.

The operational amplifiers BE027/BE037 developed by Behringer, which are used in the ULTRA-CURVE, are exceptional. They boast extreme linearity and very low distortion characteristics. To complement this design the choice of components includes high tolerance metalfilm resistors and capacitors as well as several other stringently selected elements.

Before final calibration the unit is "burnt in", which means that the unit is placed in a special oven for several hours in order to stabilize and artificially age the unit. This guarantees several years of constant performance specifications. The burn-in test conforms to military guidelines.

2.1.1 Two Independent Channels

The Behringer ULTRA-CURVE has two Channels which may be operated independently (dual mono), or software-linked together (stereo).

2.1.2 Failsafe Relays

Failsafe Relays have been incorporated into the design of the Behringer ULTRA-CURVE, which automatically and silently bypass the unit in the event of power supply disconnection or failure. These Relays are also active at switch-on to isolate the ULTRA-CURVE until the power rails have settled, thus preventing the possibility of a potentially damaging switch-on thump.

2.2 INPUTS AND OUTPUTS

2.2.1 Analogue Inputs and Outputs

As standard, the Behringer ULTRA-CURVE is installed with electronically servo-balanced Inputs and Outputs. The new circuit design features automatic hum and noise reduction for balanced signals and thus allows for trouble-free operation, even at high operating levels. Externally induced mains hum etc. will be effectively suppressed.

The automatic servo-function recognizes the presence of unbalanced connectors and adjusts the nominal level internally to avoid level differences between the Input and Output (correction 6 dB).

2.2.2 Reference Microphone Input

The Reference Microphone Input has a balanced Input Pre-Amplifier which raises the input signal by 20 dB. Additionally, it has 15 Volt Phantom Power. This Phantom Power design also allows the use of microphones which do not require Phantom Power.

2.2.3 Digital Input and Output (Option)

The Digital Input and Output (AES/EBU interface) are non earth balanced. The use of high quality transformers guarantees a noise and hum free signal transfer.

2.2.4 MIDI

The MIDI connectors (IN/OUT/THRU) are standard 5 pin DIN sockets. Signal transfer is potential free via opto-coupler.

3.0 BLOCK DIAGRAMS

3.1 HARDWARE

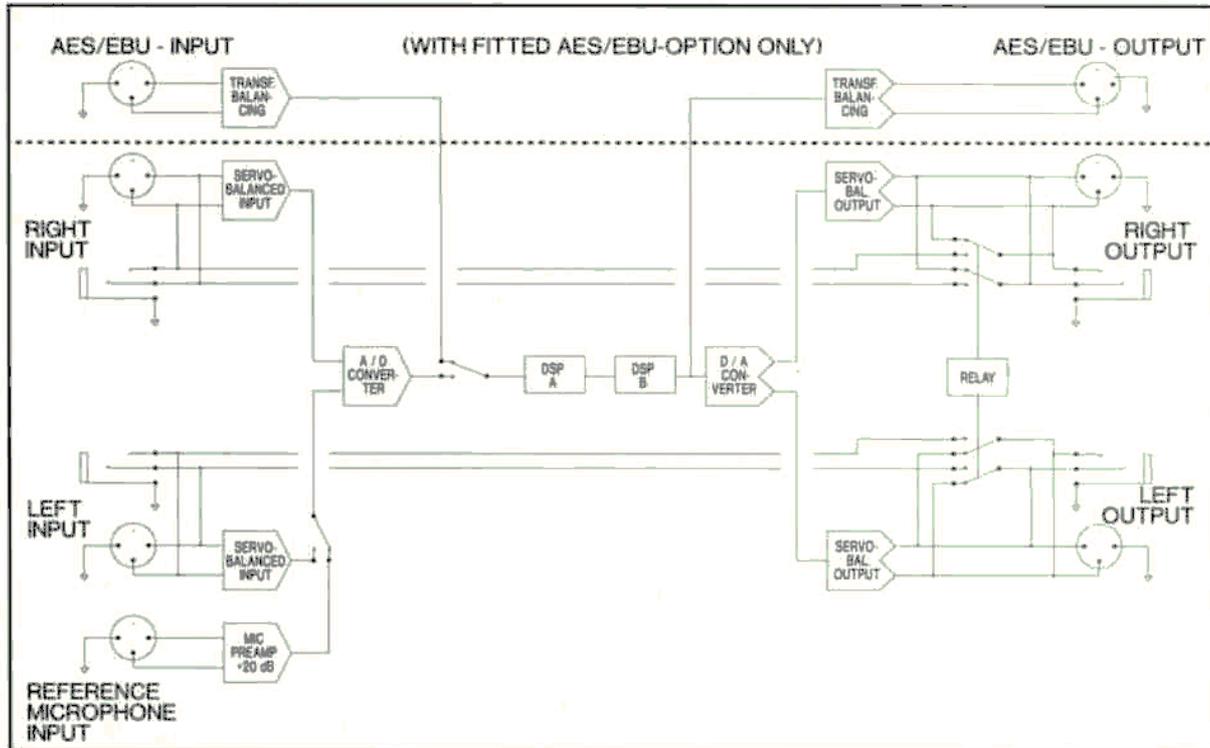


Fig. 3.1: Block diagram of the ULTRA-CURVE - Hardware

The analogue input signals first pass through the electronic balancing amplifier and are then fed to the A/D converters. Here they are converted into a time division multiplex digital signal suitable for the DSPs.

The reference microphone input feeds a balanced amplifier, which raises the signal level by 20 dB. The signal is then sent through a switch to one of the ADC inputs. Switching onto a particular input can be carried out in the RTA- or RTA-SETUP menu.

The digital input signal goes straight through the transformer balanced input directly to the DSPs (applicable only when the AES/EBU option is installed).

Switching between the analogue and digital input sources is done in the SETUP-menu.

Signal processing is accomplished by the two DSPs. They are succeeded by the DACs, which reconstruct the left and right analogue signals. Finally, they are sent to the electronically balanced outputs.

In the case of an ULTRA-CURVE with fitted AES/EBU option, the digital signal, on leaving the DSPs, will be sent to the digital output, as well as to the D/A converter. The digital output is transformer balanced, providing a transmission in the digital domain free of induced hum and noise.

3.2 SOFTWARE

The digital signal processing in the ULTRA-CURVE takes place in the two DSPs, each of which has a specific function. In equalizer mode, each channel has a DSP assigned to it. In analyzer mode, the signal processing is divided between the two DSPs, the first dealing with the RTA functions, the second looking after signal generation and equalizing. The procedures which we will describe here are carried out extremely quickly, in some cases simultaneously. The sequence as described does not always reflect the real processing sequence, instead it follows a more logical train of thought.

3.2.1 Equalizer Mode

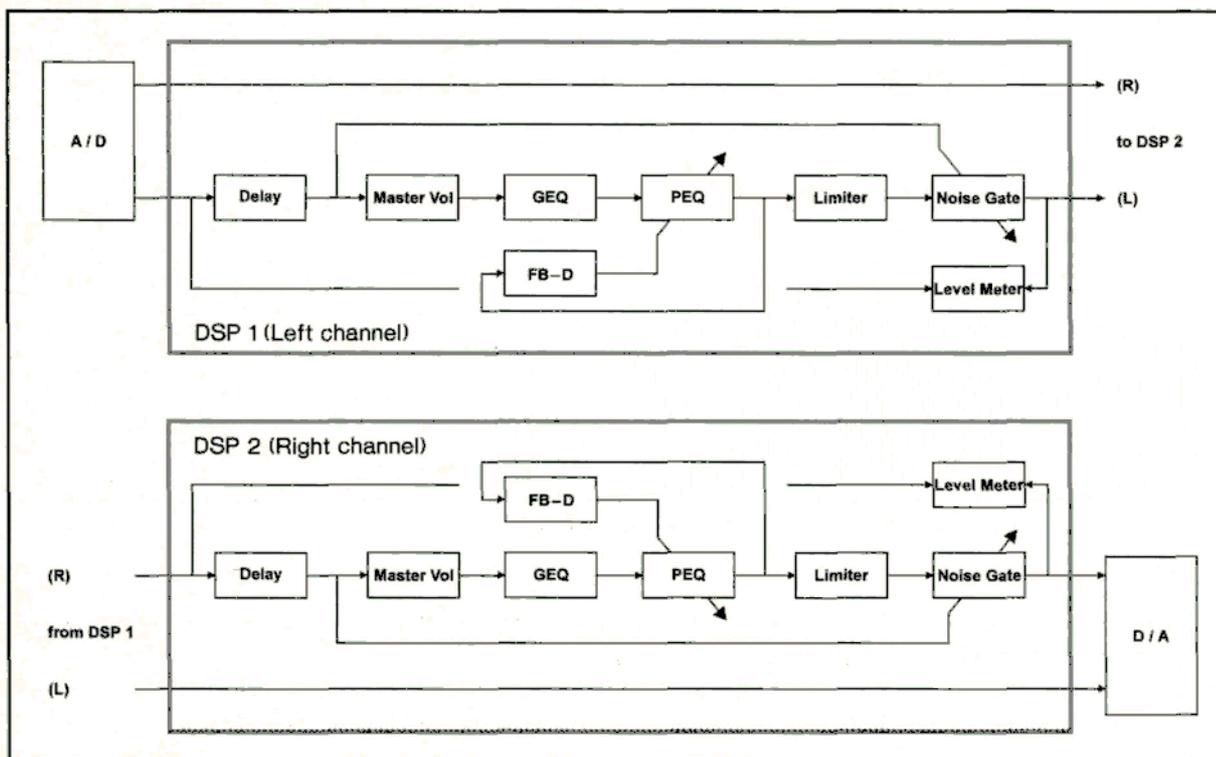


Fig. 3.2: Block diagram of the ULTRA-CURVE software in equalizer mode

DSP 1 sends the unprocessed audio signal for the right channel to the second DSP and processes the signal for the left channel.

At first, the level will be determined before processing. This information is sent to and displayed by the LEVEL METER.

Apart from this the input signal will be delayed if the DELAY option is installed, and a delay time is set. Once again, a level will be determined, this time from the delayed signal. This will be used to control the NOISE GATE. At the same time, the overall level (MASTER VOL) will be set. This is done prior to processing, so that the processing filters in the signal path will not be overloaded.

Next are the graphic and parametric filters. 34 filters will be operated in sequence, starting with the lowest frequency (20 Hz). The last three in the sequence are the parametric filters. They have a special characteristic in that they receive control signals from the FEEDBACK DESTROYER.

After processing by the filters the signal will be controlled for feedback. When the FEEDBACK DESTROYER is switched on, a control signal for one of the parametric filters will be generated.

In addition to this the filtered signal will be sent to the digital LIMITER. When switched on, it ensures that the signal level will be limited to the level set. Finally, we find the level control of the NOISE GATE. Here the input level is continuously compared with the THRESHOLD setting. As soon as the level drops below the threshold, the ULTRA-CURVE output will be muted.

Following this final processing function, the output level will be measured and sent to the LEVEL METER. The processed signal for the left channel will then be sent on to DSP 2. It carries out the same processing as above, but solely for the right channel.

3.2.2 Analyzer Mode

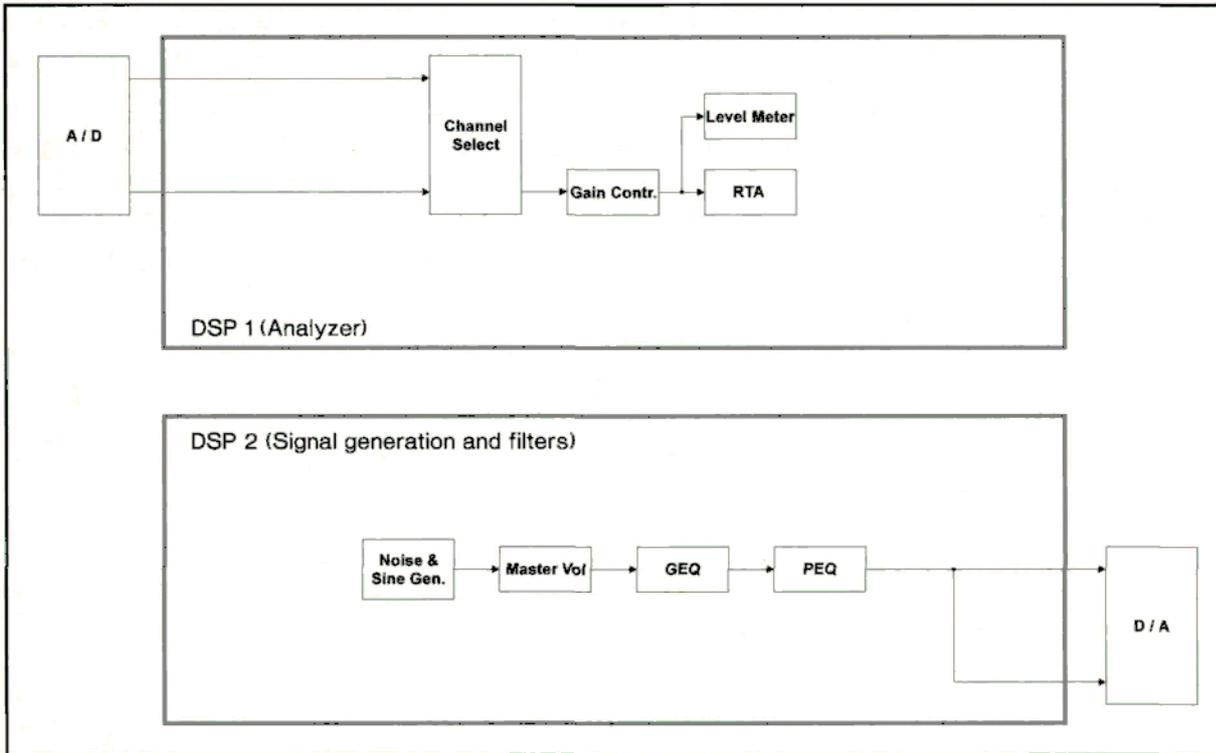


Fig. 3.3: Block diagram of the ULTRA-CURVE software in RTA mode

DSP 1

First we must choose a signal source for measurement. When MONO is selected as signal source, both input channels will be summed,

Next the signal level will be adjusted. This adjustment may be fully automatic (GAIN MODE = AUTO). Finally, the signal will be analyzed and the measured levels prepared for the display.

DSP 2

First of all, the signal to be measured will be generated (a sine wave with variable frequency, or White or Pink Noise).

The signal will be then adjusted to the required level.

Finally, the measurement signal will be filtered, just as in equalizer mode. The filter processing corresponds to the equalizer setting of the channel currently active.

The measurement signal generated and filtered will be sent simultaneously to both outputs!

When the AUTO-Q function is switched on, the filter parameters for the selected channel(s) and the output selection are automatically set.

4.0 INSTALLATION

Your Behringer ULTRA-CURVE was carefully packed in the factory and the packaging was designed to protect the unit from rough handling. Nevertheless, we recommend that you carefully examine the packaging and its contents for any signs of physical damage, which may have occurred in transit.

If the unit is damaged, please do not return it to us, but notify your dealer and the shipping company immediately, otherwise claims for damage or replacement may not be granted. Shipping claims must be made by the consignee.

4.1 RACK MOUNTING

The Behringer ULTRA-CURVE fits into two standard rack units of space (3 1/2"). Please allow at least an additional 4" depth for the connectors on the back panel. Be sure that there is enough air space around the unit for cooling and please do not place the ULTRA-CURVE on high temperature devices such as power amplifiers etc. to avoid overheating.

4.2 CONNECTORS

The ULTRA-CURVE can be installed using either XLR or standard 1/4" Jacks. Although the inputs and outputs are fully balanced, the automatic servo-function allows them to operate with unbalanced sources/loads.

4.2.1 Impedances

The input has an impedance of 40 kOhms and can be driven by most input sources. If a device's output requires a load of 600 Ohms (provided with most output transformers), a 600 Ohm resistor should be tied across pins 2 and 3 on the input connector.

The ULTRA-CURVE'S outputs are electronically balanced and have an output impedance of 40 Ohms. When driving transformer coupled loads, it may be necessary to create a 600 Ohm source impedance. For this purpose, install two 287 Ohm resistors (tolerance: 1%) in series with pins 2 and 3.

4.2.2 Unbalanced/Balanced Operation

90% of all mistakes in audio installations can be attributed to incorrect and defective audio connections! In order to utilize the Behringer ULTRA-CURVE to its full potential, please pay special attention to the following section.

For better understanding, the technical difference between unbalanced and balanced systems must be clarified:

The unbalanced system

Unbalanced operation is characterized by a single conductor shielded cable with the center conductor carrying the signal and the shield at ground.

The balanced system

A balanced operation is defined as a two conductor shielded cable, where each of the two center conductors carry the signal but of opposite phase. They have equal but inverted potential differences from that of ground.

The advantage of the balanced system is based on the effect that the differential amplifier in a subsequent device suppresses all equal phased noise which has been induced during its transmission down the cable link. However, the original signal will be amplified and retain all its original integrity.

In this way, audio signals can be transmitted without interference or loss across long distances.

Balanced or unbalanced systems require different wiring. Please read the next section carefully and pay close attention to the correct wiring requirements of the units in the audio chain.

4.2.3 The Correct Wiring for Balanced Operation

If the unit preceding the ULTRA-CURVE uses output balancing, we recommend that you use balanced audio connections. This will avoid interference such as mains hum etc.

For maximum hum rejection, you should avoid common grounding, which means, grounding the ULTRA-CURVE'S input and output.

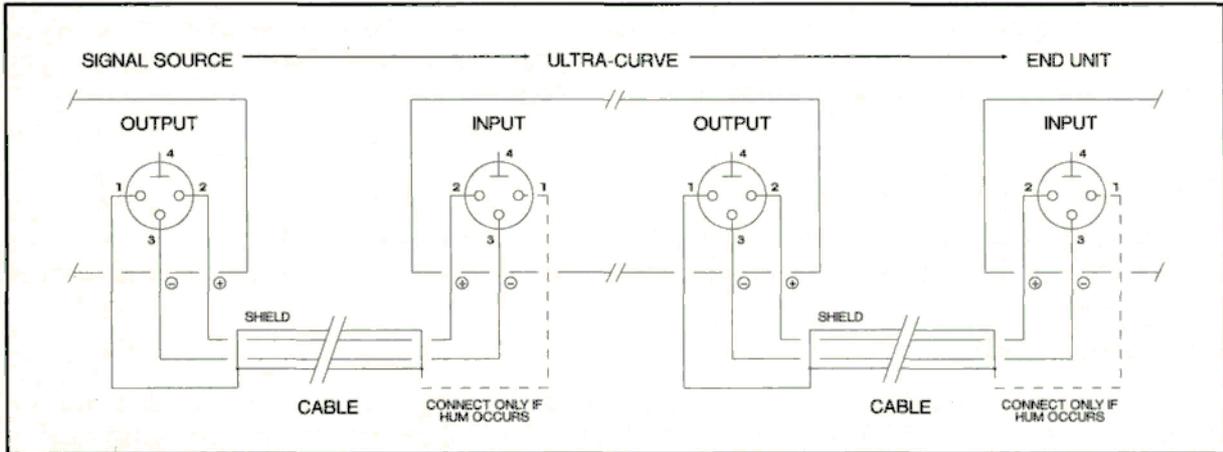


Fig. 4.1: The correct wiring of the balanced system

We recommend that you connect the shield of the input cable to the ground of the signal source, making sure that the shield is not connected to the ULTRA-CURVE'S input connector.

At the output, the shield of the cable is connected to the ground of the ULTRA-CURVE, but making sure that the shield of the corresponding cable's end is not connected to the ground of the subsequent unit.

Generally speaking, the shield connection will be tied to the source units, but not to destination units. Please avoid at all costs linking pin 1 and 4 (ground tie) of the XLR connector.

If you still develop hum, it may be helpful in some cases to connect the shield on the input of the subsequent device also.

4.3 OPERATION WITH XLR CONNECTORS

4.3.1 Balanced Operation with XLR Connectors

The Behringer ULTRA-CURVE also uses XLR connectors. We recommend, in accordance with the internationally agreed IEC 268-12 standard, pin 1 = ground (sleeve), pin 2 = positive input and pin 3 = negative input. We advise that you adhere to this standard, in order to provide compatibility with preceding or subsequent units.

The following figure 4.2 shows the correct connection for the balanced input wiring, whereas figure 4.3 shows the correct connection for the balanced output wiring for the ULTRA-CURVE. Please note that you can distinguish between the figures by observing the shield connections.

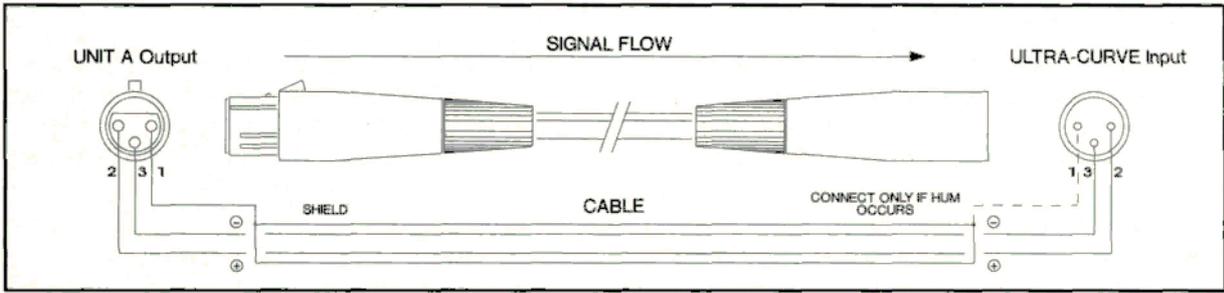


Fig. 4.2: Balanced ULTRA-CURVE input wiring using XLR connectors

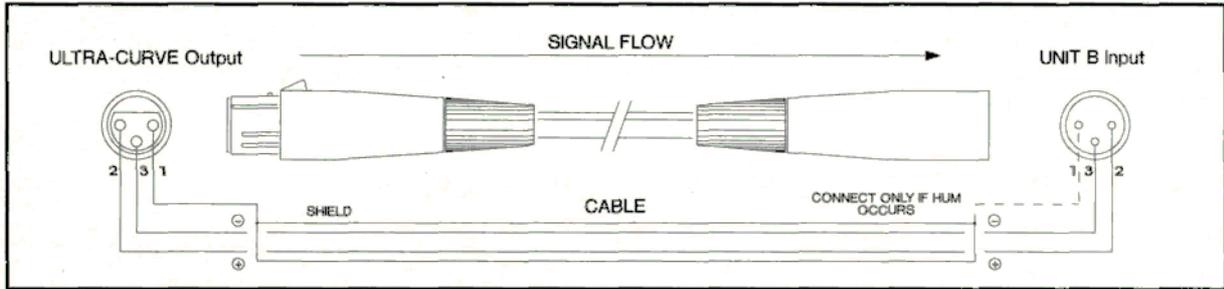


Fig. 4.3: Balanced ULTRA-CURVE output wiring using XLR connectors

4.3.2 Unbalanced Operation with XLR Connectors

Although the ULTRA-CURVE is equipped with electronically balanced inputs and outputs, it can also function unbalanced. The automatic servo-function recognizes the connection of unbalanced connectors and compensates for the 6 dB level difference which occurs, when used with unbalanced connections.

If unbalanced operation is required, please connect pin 3 to pin 1 (ground) of the XLR connector. As a result pin 2 carries the positive (+/hot) signal. If pin 3 and pin 1 are not joined, the negative input will be "open" resulting in a drastic deterioration in the signal-to-noise ratio.

This applies to both the input and output connections. Please note that in this application, the cable shield has to be connected on both ends.

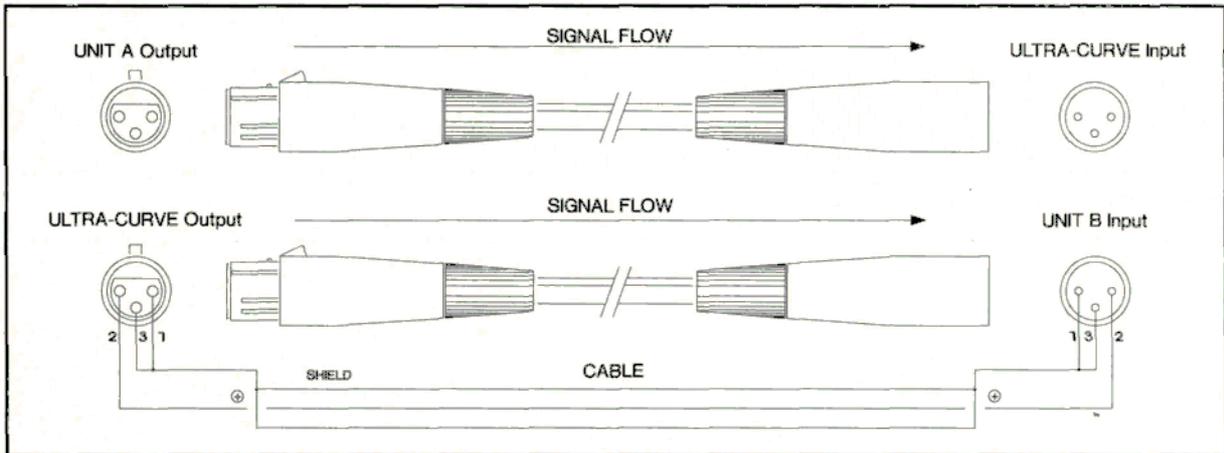


Fig. 4.4: Unbalanced input and output wiring using XLR connectors

4.3.3 Connecting a Reference Microphone

A Reference Microphone should be connected to the MIC INPUT on the rear panel of the ULTRA CURVE. Ideally, a microphone manufactured specifically for reference/measurement purposes should be used. If such a microphone is not available, a suitable alternative is the use of a good quality condenser microphone, using an omni-directional pick-up pattern. (The 15 Volt phantom power supply of the ULTRA-CURVE can be used to power such microphones - check your microphone's handbook to be sure that it is able to work with this power supply.) As a last resort, microphones with a cardioid (uni-directional) characteristic can be used, providing they have a fairly linear frequency response. If you are using such a microphone, the following points should be observed:

1. Sound approaching the microphone from the sides will have a 'coloured' frequency response, as the directional response of the microphone is frequency dependent.
2. When using microphones with a 'proximity effect', which most uni-directional microphones have, remember that sound sources close to the microphone will be picked up with a boosted low frequency response.

4.4 OPERATION WITH 1/4" JACK PLUGS

The Behringer ULTRA-CURVE, except its MIC INPUT, can also be used with standard 1/4" Jack plugs. Please refer to the following sections for correct wiring:

4.4.1 Balanced Operation with 1/4" Jack Plugs

If the unit preceding the ULTRA-CURVE uses output balancing or if the unit subsequent to the ULTRA-CURVE uses input balancing, then we recommend the following adaptations. Figures 4.5 and 4.6 show the correct connection for stereo Jack to Jack operation.

Figure 4.5 shows the correct way to connect the balanced input, whereas figure 4.6 shows the correct way to connect the ULTRA-CURVE'S output. Please note that you can distinguish between the figures by observing the shield connections.

If you still develop hum, it may be helpful in some cases to connect the shield on the input of the subsequent device also.

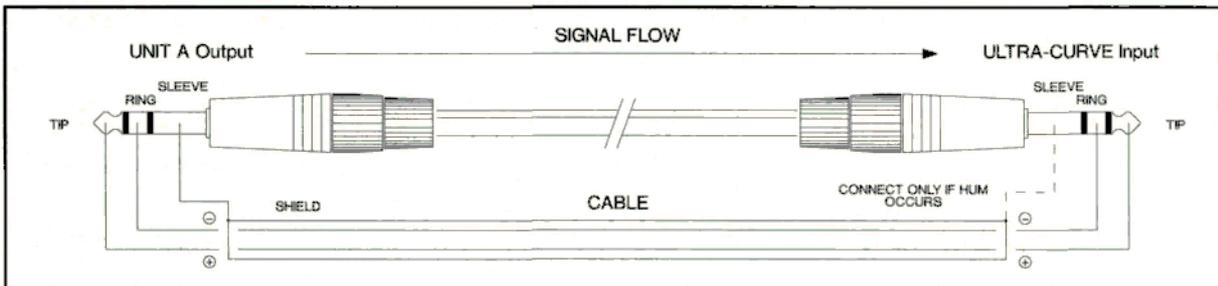


Fig. 4.5: Balanced ULTRA-CURVE input wiring with 1/4" Jack connectors

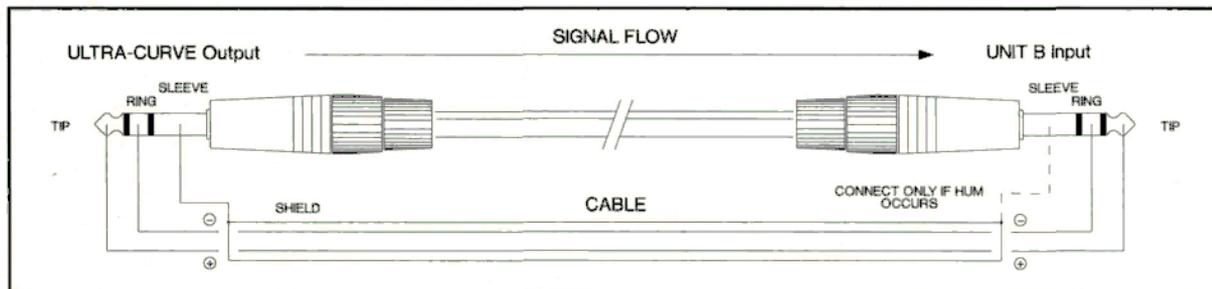


Fig. 4.6: Balanced ULTRA-CURVE output wiring with 1/4" Jack connectors

4.4.2 Unbalanced Operation with 1/4" Jack Plugs

In applications that do not require balanced connections, we recommend that you use a single conductor shielded cable with two mono Jack plugs. Please make sure that the shield is connected at both ends.

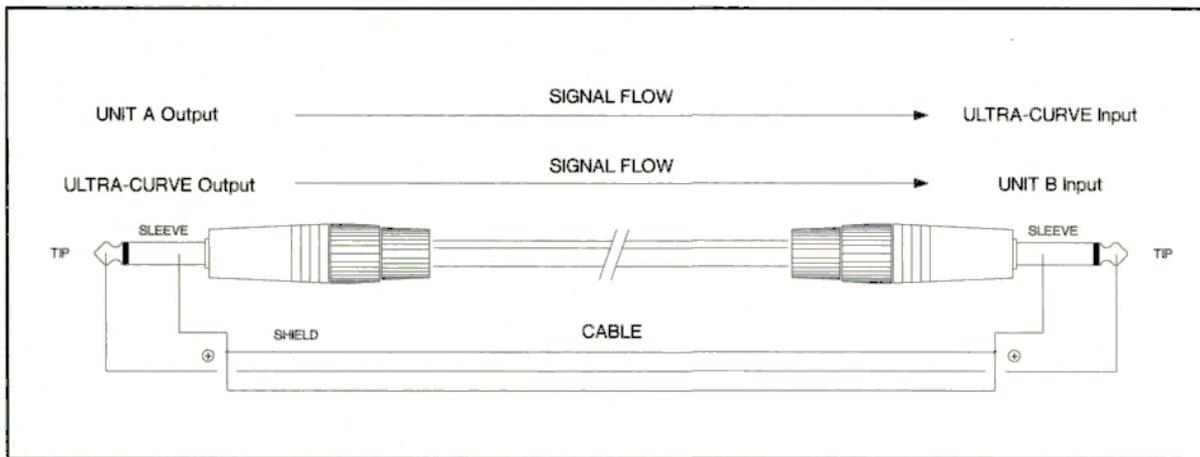


Fig. 4.7: Unbalanced input and output wiring with 1/4" Jack connectors

4.5 DIGITAL AUDIO CONNECTION PER AES/EBU (Optional)

The AES/EBU* interface is the most widely used digital interface for professional audio devices. The connection is balanced, negative earth, using bipolar shielded cable with XLR connectors. We recommend the use of a high quality low capacitance cable capable of transmitting the wide bandwidth signal (with frequencies of over 3 MHz) error-free. The AES/EBU signal can carry, in addition to the pure audio material (up to 24 bit), various code signals using a built in emphasis, including the sampling rate present, time code information and user-definable bits. The S/P-DIF* digital format found in consumer products has similarities in its data structure to the AES/EBU format. It is in principle possible to connect an S/P-DIF device to the ULTRA-CURVE AES/EBU input, although this was not intended in the design of the two formats. The S/P-DIF connector is normally an unbalanced RCA socket, requiring the use of an adaptor. Connect the tip of the RCA socket to pin 2 of the XLR, and the RCA shield to pin 3 of the XLR. The connection between the two devices should be as short as possible.

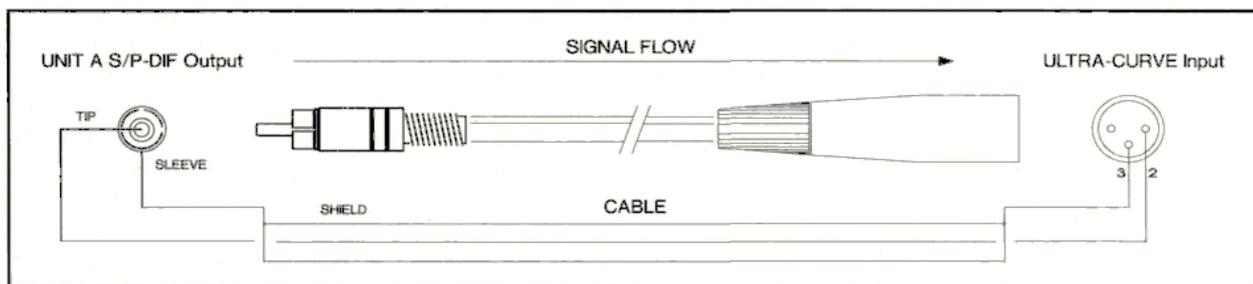


Fig. 4.8: Adaptor S/P DIF Out > ULTRA-CURVE AES/EBU In

Connecting from the ULTRA-CURVE AES/EBU output to an S/P-DIF input will probably not work, because the copy prohibit function present at the S/P-DIF device will be triggered by a channel status bit, or possibly another AES/EBU defined bit, preventing data transfer.

4.6 MIDI CONNECTIONS

The MIDI* standard was developed in the early 1980s to allow electronic musical instruments from different manufacturers to communicate with each other. The use of MIDI has developed over the intervening years to the stage where it is now common to find complete recording studios operating entirely on a MIDI basis. The centrepiece in such a studio is usually a computer running a sequencer software which not only controls various keyboards, samplers and sound modules, but can also run the programming of outboard effect devices, typically digital reverberation and delay units. The ULTRA-CURVE may be controlled in real time in this studio environment.

* AES stands for Audio Engineering Society, EBU for European Broadcasting Union, S/P-DIF for Sony Philips Digital Interface Format, MIDI for Musical Instruments Digital Interface.

The MIDI connectors found on the rear panel are of the universally-used 5 pin DIN type. You require suitable MIDI cables to connect the ULTRA-CURVE to other MIDI devices. Normally complete cables will be purchased for this use, you can of course make your own, using a high quality cable with two cores and shielding (like microphone cable), with as connectors two good 180 degree DIN plugs. Pin 2 (center) is connected to the cable's shield, pins 4 and 5 (left and right next to 2) carry the two cores, pins 1 and 3 are not used. MIDI cables should have a maximum length not exceeding 45 feet.

MIDI IN: Receives MIDI data. The input channel will be chosen in the SETUP menu. Here you control:

Program change commands to select the 100 equalizer memory positions. Controller data, under the control numbers 64 - 127. Controller 64 is used to control the lowest fader of the left channel, controller 65 the next fader, and so on up to controller 94. Controller 95 controls the master fader. Controllers 96 - 127 have the corresponding functions for the right channel, controller 127 being responsible for the right master fader,

MIDI THRU: The MIDI THRU socket accesses the incoming MIDI signal, allowing several ULTRA-CURVE units to be serially connected.

MIDI OUT: Has no function as yet, but may be required for use by future software updates.

You'll find the ULTRA-CURVE'S MIDI Implementation Chart in chapter 8.2. A software program to run on a PC, enabling convenient control of several ULTRA-CURVES, is currently under development.

4.7 MAINS CONNECTION

The mains connection of the ULTRA-CURVE is made by using a mains cable and a standard IEC receptacle. It meets all of the international safety certification requirements.



Please make sure that all units have a proper ground connection. For your own safety, it is advisable not to remove the ground connection within the units or at the supply, or fail to make this connection at all. The audio ground of the ULTRA-CURVE is internally capacitor de-coupled. to isolate it from the supply earth. It is therefore not advantageous to attempt ground loop problem solving using this method.

4.7.1 Operating Voltage Selector

Before you switch on the unit, check that it is configured to match your AC mains voltage requirements. If it does not comply, then it is necessary to switch the operating voltage to the correct supply requirements BEFORE turning on the unit, otherwise the unit could be severely damaged. You will find this combined fuse holder/voltage selector at the back, adjacent to the IEC receptacle.



Please note that the AC voltage selection is defined by the position of the fuse holder. If you intend to change the operating voltage, remove the fuse holder and twist it by 180 degrees before you reinsert it. Matching the two markers monitors the selected voltage.

4.7.2 Safety Fuse Replacement

A safety fuse protects the unit from serious defects. If the fuse blows, this is a warning sign and always indicates that the circuit is overloaded. The fault must always be repaired before the fuse is replaced.



If the safety fuse is faulty and needs replacing after the unit is repaired, please make sure that you replace it only with the identical type and rating. NEVER use fuses of different ratings or cover faulty fuses with aluminium foil. This can cause fire and electric shocks and will endanger your life and the lives of others.

For 200-240 Volts the fuse rating is 160 mA slow-blow and 315 mA slow-blow for mains voltages of 100-120 Volts.

5.0 CONTROLS

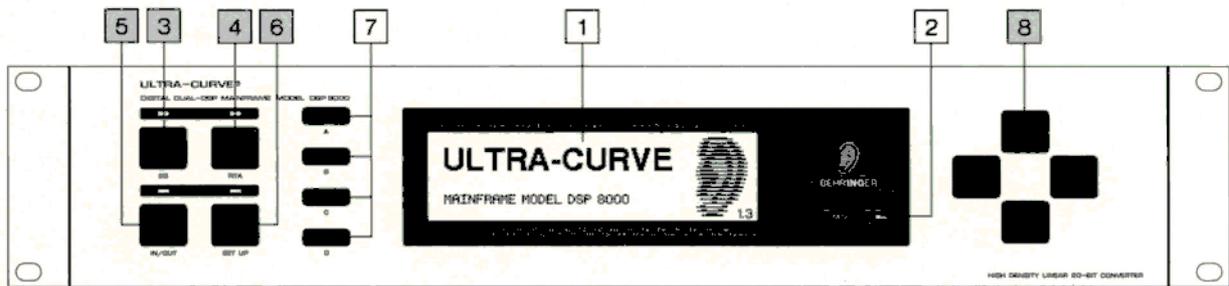


Fig. 5.1: The control surface of the ULTRA-CURVE

5.1 THE FRONT PANEL LAYOUT OF THE ULTRA-CURVE

[1] DISPLAY

The heart of the front panel is the LED-backlighted 240 x 64 active LCD DISPLAY.

[2] MIDI - LED

To the right of the display you will find a LED which registers incoming MIDI messages. Control of the ULTRA-CURVE is carried out by using three KEYGROUPS, each consisting of four keys:

5.1.1 Operating Methods and Bypass Mode

On the left of the front panel the keys for operation and bypass are to be found, above each is an associated status LED.

[3] EQ - KEY

Switches the ULTRA-CURVE into EQUALIZER mode. In this mode, the EQ, FEEDBACK DESTROYER and DELAY functions may be used.

[4] RTA - KEY

Switches the ULTRA-CURVE into ANALYZER mode. This mode is solely concerned with measuring, the sound will not be affected!

[5] IN/OUT - KEY

The ULTRA-CURVE can be switched into the signal path (LED is green) or switched out (Bypass, LED dark). The LED flickering red indicates DSP overflow. This does not necessarily mean 'clipping'. Flickering starts as soon as an internal overflow in one of the filters occurs, while input and output levels may be o.k.

[6] SETUP - KEY

The SETUP key allows entry into the SETUP menus where all the basic adjustments of the device are to be found, such as the choice of input source, sampler rate, password protection, MIDI configuration etc.

5.1.2 Softkeys

[7] KEYS A, B, C, D

To the left of the display four 'SOFTKEYS', labelled A, B, C and D respectively, are to be found arranged vertically. Their functions can be defined by the user software and displayed to the immediate right of each key by the appropriate PICTOGRAM in the display.

Each pictogram and its associated functions will be comprehensively explained in chapter 6. You will find function diagrams for both EQ and RTA mode as well as a list of all pictograms used next to the back cover.

5.1.3 The Cursor Keys

To the right of the display the

[8] CURSOR KEYS

are to be found. These are used:

- 1.) to select individual filter frequencies, and the master fader in EQUALIZER mode (horizontal)
- 2.) to adjust the value of each selected frequency (vertical)
- 3.) to position the measurement cursor in ANALYZER mode (horizontal)
- 4.) in both operating modes, to choose the program position (vertical)
- 5.) to select a field in the SETUP menu (horizontal and vertical)

In each case pressing on the opposite key while holding the key being used will accelerate the operation being carried out.

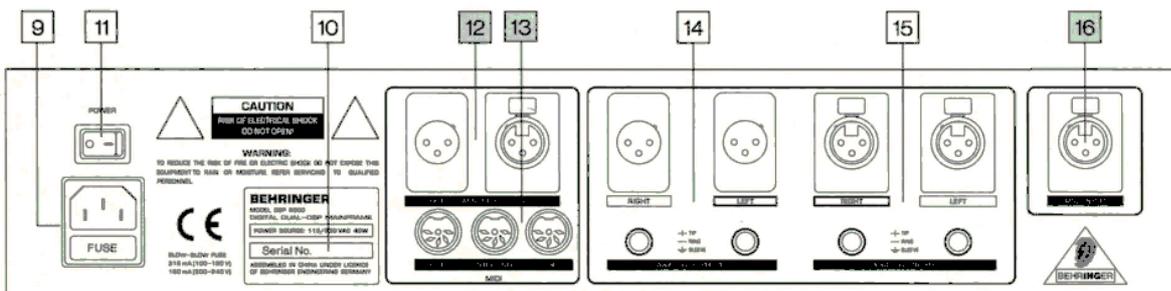


Fig. 5.2: The back panel layout of the ULTRA-CURVE

5.2 THE BACK PANEL LAYOUT OF THE ULTRA-CURVE

[9] MAINS CONNECTOR / FUSE HOLDER / VOLTAGE SELECTOR

Before you connect the unit, please make sure that the displayed voltage corresponds to your mains supply.



Please note that the AC voltage selection is defined by the position of the Fuse Holder. If you intend to change the operating voltage, remove the Fuse Holder and twist it by 180 degrees before you re-insert it. Matching the two markers monitors the selected voltage.

Please note that, depending on the mains voltage supplied to the unit, the correct fuse type and rate must be installed (see chapter 8 'SPECIFICATIONS').

Please use the enclosed mains cable to connect the unit to the mains power supply.

[10] SERIAL NUMBER

Please take the time to make a note of the Serial Number in the space provided on the enclosed Warranty Registration Card. Put the instruction manual in a safe place and return the completed Warranty Registration Card to us within 8 days of purchase, making sure that the dealer stamp has been acquired.

[11] MAINS SWITCH

The Mains Switch is to be found above the mains socket.

[12] AES/EBU IN and AES/EBU OUT

These are the ULTRA-CURVE's Digital Input and Output (optional).

[13] MIDI OUT / THROUGH / IN

These are the ULTRA-CURVE's MIDI connectors.

[14] ANALOG OUTPUTS

These are the ULTRA-CURVE's Analogue Outputs.

[15] ANALOG INPUTS

These are the ULTRA-CURVE's Analogue Inputs.

[16] MIC INPUT

This is the Input socket for the Reference Microphone.

6.0 OPERATION

The Behringer ULTRA-CURVE is a flexible, universally applicable sound processing- and measurement device, whose operations may be divided into two basic areas. Signal Processor (Equalizer, EQ), or Real Time Analyzer (RTA). For this reason, you always operate in either EQ or RTA mode. Simultaneous operation of both is not possible! When the ULTRA-CURVE is switched from one mode to the other, the outputs will be briefly muted.

6.1 GENERAL SETUP

The SETUP-Menu consists of three windows. Having the EQ or RTA mode active will determine which window is opened on going into SETUP. These windows will be referred to as the EQ and RTA windows. Pressing the SETUP key once more will show the third window, which has basic functions shared by, and affecting both operating modes. The basic configuration will be determined in this window, which will be referred to as the Configuration Window. The other windows can only be reached from here by leaving the SETUP menu by pressing either the EQ or RTA key, and then re-pressing to enter the relevant window. The EQ and RTA windows will be explained in chapters 6.2.5 and 6.3.5 respectively. The following deals solely with the Configuration Window.



Fig. 6.1: Configuration Window in the ULTRA-CURVEs GENERAL SETUP menu

The Cursor Keys are used to select the value or parameter to be changed. The active edit field will be highlighted in reverse colour. Changing status or a value can be achieved by use of the “+ / + / - / - “ softkeys.

INPUT

The Input field is used to determine whether the input signal should be derived from the optional Digital Input, or from the Analogue Input. Furthermore, in analogue mode, this is where you can select the sampling rate, 32 kHz, 44.1 kHz, and 48 kHz being the available rates. The Digital Input will automatically synchronize to whichever of these frequencies is being used. When changing sample rates, the ULTRA-CURVE will be muted for approx. 1 sec., as all the filter parameters have to be re-calculated.



In purely analogue mode the 48 kHz rate should be used. Apart from the fact that the high sample rate gives the widest frequency response and correspondingly the best possible sound, at this rate the fastest signal processing takes place.

If the ULTRA-CURVE fails to send an output, it could be due to an incorrect input configuration.

VIEWING ANGLE

Viewing Angle controls the contrast adjustment for the display, in increments from 0 to 31. A second possibility to adjust display contrast is pressing Cursor UP or Cursor DOWN respectively while pressing the SETUP key.

MIDI CHANNEL

Serves to set the MIDI Input Channel, possible settings are: OFF ALL, as well as CHANNELS 1 -16.

RTA LOCK

When RTA lock is switched on, it is not possible to enter RTA mode. This is designed to prevent unauthorized or accidental selection of this mode. RTA LOCK should only be de-activated when the ULTRA-CURVE is to be used specifically to analyze sound, or if it is to be used in conjunction with another ULTRA-CURVE operating as an equalizer solely for analysis purposes. (Think of the consequences of the situation where you are using the ULTRA-CURVE as a P.A. equalizer, and somebody, by accident, presses the RTA key. This could even, in the worst case, result in the concert sound which you had so carefully equalized being replaced by the Pink Noise of the analyzer, and this at the full power rating of your system!)

SECURITY

The SECURITY function offers effective protection against unauthorized use of the ULTRA-CURVE. UNLOCK means, that all functions may be accessed, with the exception of the programs which are secured under PROTECT MEMORY. LOCK prevents any of the adjustment parameters on the device being accessed, the only exceptions being the DISPLAY of the present equalizer setting, plus the input and output level with the LEVEL METER. The only other way to make changes is via MIDI. In order to use the SECURITY function, a PASSWORD must be entered, which is done using the cursor keys and the softkeys. The softkeys are used to select the letter or symbol to be used, and they have the following functions:

A = "OK" confirms entry of the password and immediately activates the LOCK status.

B = "←" and C = "→" and move the cursor left and right within the PASSWORD.

D = "CLEAR" erases any characters which may have already been entered.

To abolish the LOCK condition: go into the SETUP menu. The relevant PASSWORD field is immediately accessed, and the PASSWORD may be re-entered. This causes the ULTRA-CURVE to return to the UNLOCK status. If the device is locked without entering the PASSWORD, simply enter OK to UNLOCK.

DO NOT FORGET THE PASSWORD! If this happens, there is only one way to remove it: You must open the casing of the ULTRA-CURVE, and take the battery out for a short while. After replacing it, and switching back on, the original factory presets will be re-loaded. Warning! Doing this means you lose all your programs. AND void the warranty!

PROTECT MEM

The PROTECT MEMORY function switches the write protect for the program memory on and off. You might use a PASSWORD in this case, too.

EQ LO / EQ HI

The two functions EQ LO and EQ HI determine the area of program memory which will be protected by the PROTECT MEMORY function. EQ LO determines the lowest, EQ HI the highest program number of the protected area. Switching OFF means the PROTECT MEMORY function is de-activated only for the equalizer.

RTA LO / RTA HI

The two functions operate identically to EQ LO and EQ HI, except they determine the protection of the RTA programs.

All the SETUP settings are stored when switching off the ULTRA-CURVE, and remain unchanged until you re-edit them.



6.2 THE EQUALIZER

Upon switching on the ULTRA-CURVE you will be presented either the main EQUALIZER (EQ), or ANALYZER (RTA) window. By pressing the EQ key, you switch from RTA- into EQ mode.

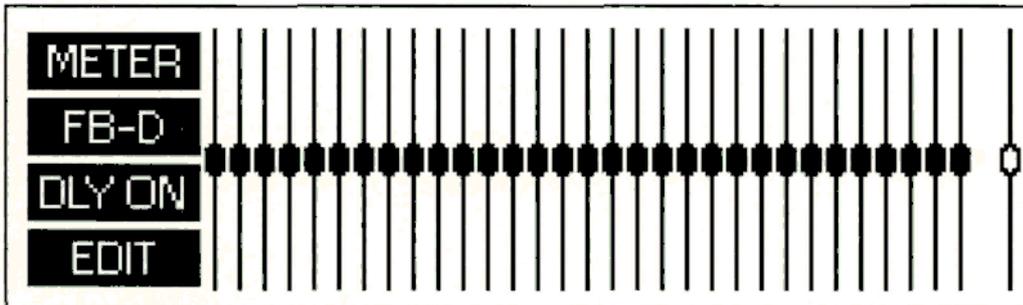


Fig. 6.2: Main EQ window of the ULTRA-CURVE

The display shows a 31-band GRAPHIC EQUALIZER, along with, slightly separated on the right hand side, the main fader for overall level control. On the left are the pictograms for the softkeys, which are used to open the sub-menus.

6.2.1 Operating the Graphic Equalizer

The selected controller is shown highlighted in the display. The vertical cursor keys are used to adjust levels, the horizontal keys to select the controller to be adjusted. When you depress a cursor key, an information window appears showing the selected frequency, the level of boost or attenuation applied to each of the two channels, as well as the program number and program name.

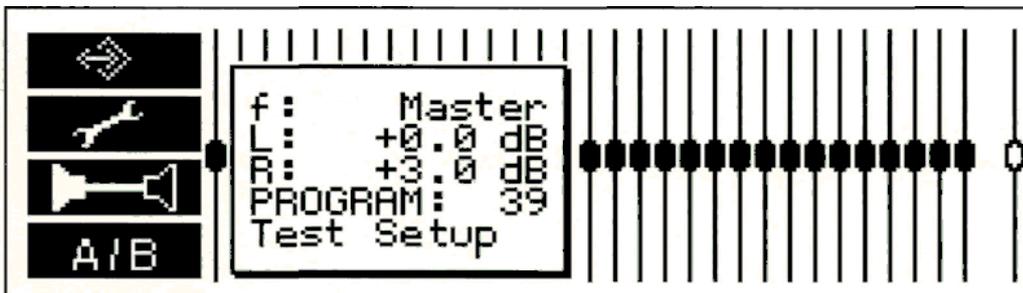


Fig. 6.3: Graphic EQ information window

The information window disappears if, after 4 seconds, no further key has been pressed.

The following points should be noted when using the cursor keys:

- ▲ DEPRESSING a key ONCE will result in a parameter changing by the smallest applicable increment. The adjacent fader will be selected, or a level will be adjusted by 0.5 dB.
- ▲ Depressing and HOLDING the cursor key results in a continuous change in the parameter. The rate of change remains constant.
- ▲ You can increase the rate of change by first DEPRESSING AND HOLDING the key used to change the relevant parameter, and then, still holding the first key, depress the one OPPOSITE.



Please pay particular attention to the special features of the ULTRA-CURVE highlighted in chapter 2.0!

6.2.2 The Level Meter

By pressing softkey A “**METER**” you leave the main EQ window and access the menu to display levels.

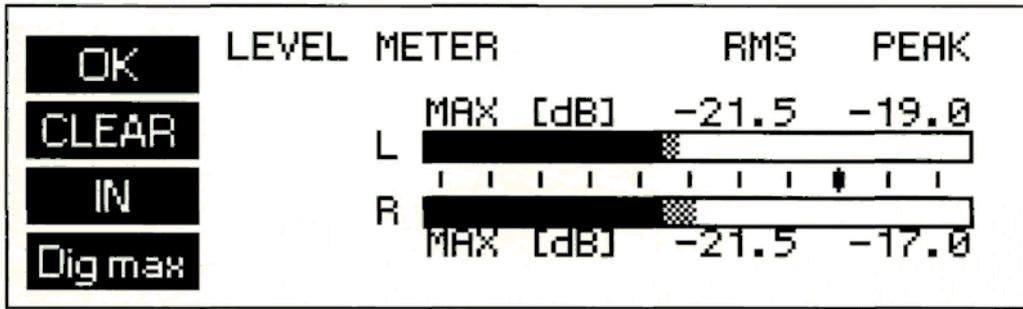


Fig. 6.4: LEVEL METER display

You can use the LEVEL METER to control the input and output levels of the ULTRA-CURVE. The bar graph display controls the effective RMS level (massive parts of the bars), and the peak level (checkered tips of the bars), both simultaneously. To save your eyes, the release time of the peak display is 1.0 sec / 20 dB. The maximum levels are memorized, and numerically displayed.

With key A “**OK**” you leave the LEVEL METER, and return to the main EQ window.

With key B “**CLEAR**” you erase the maximum levels from the memory.

With key C “**IN**” / “**OUT**” you switch the display from the ULTRA-CURVE input and output.

With key D you can choose between three different tables of reference levels. The 0 dB point is indicated by a bold marker, while at the same time, the numerical display changes.

“**Dig max**” refers to the digital peak level. THIS LEVEL MAY NOT, UNDER ANY CIRCUMSTANCES, BE EXCEEDED! This will result in a very noticeable form of distortion, which occurs much faster, and sounds very much more unpleasant, than the familiar distortion associated with analogue devices.

“**+4 dBu**” refers to the operating level found in professional audio equipment (analogue inputs and outputs of the ULTRA-CURVE).

“**-10 dBu**” refers to the operating level found in homerecording and domestic audio equipment, a typical example being tape recorders with RCA connectors.

When setting levels for digital devices - in other words, for the ULTRA-CURVEs internal level, or when using the optional AES/EBU interface - the peak level display of the 'Dig Max' scale is the ONLY one to use.

The '+4 dBu' and '-10 dBV' scales serve to monitor the analogue inputs and outputs of the ULTRA-CURVE.

Please note that the RMS level will usually be quoted in the technical specifications of analogue devices - for example, for the input sensitivity of power amplifiers.



The effective level always lies below the peak level. The difference between them depends on the signal characteristics - for a static sine wave, the effective level is about 3 dB below the peak level. For a dynamic signal the difference is in the region of 8 dB.

The Dig Max level is, of course, related to the analog input and output levels, as 0 dB Dig Max corresponds to the maximum output level of the ULTRA-CURVE.

The following example, using a sine wave at maximum amplitude, clearly illustrates the relationship between the various scales:

Scale type	Reading	
	RMS	Peak
<i>Dig Max</i>	-3 dB	0 dB
+4 dBu	+6 dB	+9 dB
-10 dBV	+18 dB	+21 dB
Absolute level:	+10 dBu / +8 dBV	

As can be seen from the above table, the ULTRA-CURVES maximum analogue output level is +10 dBu, or +8 dBV.



The ULTRA-CURVES analogue inputs can handle signals of up to +21 dBu, but it is important to remember that, in case of such high input levels, the digital LIMITER may operate if the level in the EQUALIZER is not appropriately lowered. Please refer to the operation of the digital LIMITER explained in section 6.2.6.

6.2.3 The Feedback Destroyer

By pressing softkey B “FB-D” you leave the main EQ window and go into the FEEDBACK DESTROYER menu.

OK	FEEDBACK DESTROYER			
FB-D	1L -	10.875 kHz	1R	20.000 Hz
		1/60 -48.0		1/60 +0.0
FB-D	2L S	672.50 Hz	1R	75.750 Hz
		1/60 -48.0		1/60 -18.0
FB-D	3L -	20.000 Hz	1R	20.000 Hz
		1/60 +0.0		1/60 +0.0

Fig. 6.5: FEEDBACK DESTROYER display

The display will show the current settings for all three of the ULTRA-CURVE Parametric Equalizers (selected frequency, bandwidth and degree of boost or attenuation). Additionally it will show whether the parameters are fixed (-), or are set for automatic search, to function as the FEEDBACK DESTROYER (S).

Automatic search means that the ULTRA-CURVE audio signal is continuously examined for signs of feedback. If feedback is detected, the ULTRA-CURVE will assign an appropriate filter to the relevant frequency and apply narrow band attenuation, also known as a 'Notch Filter'. The parameters which have been used will be continuously displayed.

The next feedback will be dealt with by the next available filter. When all the filters have been used, and feedback still occurs, the filter used for the first, or oldest frequency will be released to deal with the newest one. If feedback occurs very close to a frequency already being treated, or re-appears at a frequency to which a filter has already been applied, the filter already in use will have its parameters changed to deal with the new problem, i.e. the bandwidth will be widened, or the attenuation increased.



Please note the application example in section 7.2.

Using softkeys B, C and D “FB-D” you can change the function of the filters, as stereo pairs from fixed in place to FEEDBACK DESTROYER automatic search operation.

Use softkey A “OK” to return to the main EQ window.

6.2.4 Delay (Option)

By pressing softkey C “**DLY OFF**” / “**DLY ON**” the built-in signal DELAY can be switched on or off. The display shows the current status:

“**DLY OFF**” = switched off,

“**DLY ON**” = switched on, signal will be delayed by the numerical value present.

You can set the DELAY time in the EQ SETUP menu (see chapter 6.2.6). Among its many uses, it can be used to compensate for

time path differences between two sets of loudspeakers set at different distances to the listener.

See chapter 7.7 for an application example.

6.2.5 Equalizer Editing

By pressing softkey D “**EDIT**” or by using a cursor key, the function of the softkeys is changed, and this is highlighted by a new set of pictograms. With these, you can access either further sub-menus with their own functions, or carry out important switching functions. We remind you to the function diagrams next to the back cover. They give you an overview of the way all the menus and sub-menus are inserted into one other, in EQ and RTA mode respectively.

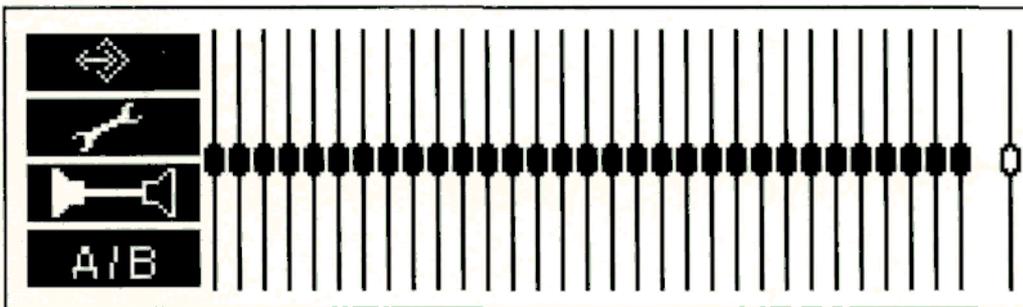


Fig. 6.6: EQ EDITING display

You can now enter:

with key A  the Program Administration,

with key B  the Toolbox,

with key C  /  the Channel Switching (STEREOLINK ON),

 /  the Channel Switching (STEREOLINK OFF) and

with key D  /  the Comparison Functions.

▲ Program Administration

A PROGRAM contains the settings for the GRAPHIC EQUALIZER, the PARAMETRIC FILTERS and the optional DELAY.

Softkey A allows access to further sub-menus which are used to organize the Program Administration.

A) Loading programs

Softkey “A” This shows, in the equalizer display, the same information window as shown when operating a fader. However, in contrast to normal equalizer operation, you cannot change the level with the cursor key, instead you can select a new program. You can confirm this with “**OK**” or cancel it with “**CANCEL**”. In both cases you are then returned back to the EDIT menu.

When you select a program to be loaded, the ULTRA-CURVE may behave differently depending on whether, in the SETUP menu, a crossfade has been set.

CROSSFADE OFF = 0 (s): as you step through the programs displayed, they will be loaded and you can then hear the effect they make (useful to try out different settings).

CROSSFADE ON -- 1 - 15 (s): the chosen program will be executed only upon confirmation. "OK" starts the crossfade between old and new programs (this is best used when you know the specific program which you wish to use). In this sub-menu you can change channels at any time with the C   softkey.

Using softkey D "CLEAR" you can reset all the current ULTRA-CURVE settings - the Graphic Equalizer, the Parametric Filters (also in FEEDBACK DESTROYER mode) and the DELAY - to zero. You will first be presented with the question "CLEAR PROGRAM IN MEMORY?" which can be confirmed with "OK". By using "CANCEL" you can stop at this point and leave the settings as they are.

 We recommend that you make use of this feature whenever you have something completely new to do and have to start everything from scratch. This way you can carry on without the danger that maybe an old FEEDBACK DESTROYER setting is in the place which could cause problems. In any case it is the quickest and most convenient way to reset all the parametric filters.

B) Saving programs

Softkey B  The procedure of saving a program is analogous to that of loading one. The memory location is selected with the vertical cursor keys, is confirmed with "OK" and cancelled with "CANCEL". If a program location is already occupied, the warning OVERWRITE PROGRAM? will appear. Pressing "OK" once more allows you to confirm the save. "CANCEL" means it does not take place, and the program already in place remains undisturbed.

C) Naming programs

Softkey C "ABC..." Important to note here is that program names can have a maximum of 12 characters. You will see a window in the equalizer display, showing the available characters. Choose the character you require with the cursor key, which is to be found in the part of the name field highlighted by blinking. You can change position using the arrows keys "←" / "→", "CLEAR" removes all characters. Having completed the name you wish to use, pressing "OK" returns you to the EDIT menu.

 When naming, remember it is always the program resident in memory which you are naming. If you want to re-name a stored program, you must first load it into memory.

D) Additive and subtractive editing of programs

Load firstly the program to which you wish to add or subtract another program, then press

Softkey D  In the pictograms for loading and saving a + or - will either appear or disappear.

If you now wish to load and add a program onto the one already in memory, press  until on softkey A you get the symb  . Using this key, you can now choose and load a further program, which will be added to the one already in memory. The same procedures apply for subtraction, and saving.

▲ The Toolbox

Using softkey B  you can enter the sub-menus which contain a number of tools which you can use to edit the graphic equalizer. They affect whichever channel is selected, other than when STEREO LINK is engaged (see section 6.2.6) when they are effective on both channels.

 The parametric filter settings will not be changed by use of the Toolbox. They may only be edited in EQ SETUP (see section 6.2.6).

A) Re-setting the graphic EQ

Softkey A "ZERO" All the graphic equalizer faders including the master fader will be re-set to zero. Having carried this out, you can confirm the changes made with "OK" cancel them with "CANCEL". In either case, you will be then returned to the EDIT menu.

With softkey C  or  respectively, you can check the status of each channel on the display, before confirming the changes as mentioned above. While doing this, you cannot make any other changes.

B) Inverting the current settings

Softkey B “**INTERVENT**” This causes the levels of all the graphic faders, with the exception of the master fader, to invert. I.e. a value of +5 becomes -5, -2 becomes +2 etc. This edit can be confirmed as above.

C) Copying the current setting to the other channel

Softkey C  /  The current setting will be copied to the other channel. Confirmation as above.

D) The shelving tool

Softkey D  You will be presented with the shelving menu. By repeatedly pressing softkey D you can switch between three different tools:

-  creates a shelving curve below the selected frequency,
-  creates a shelving curve above the selected frequency,
-  creates a peaking response centered on the selected frequency.

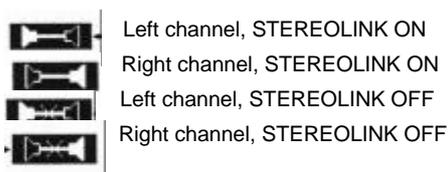
You can use the horizontal cursor keys to choose the frequency at which or from which the tool will operate. You can use the vertical cursor keys to adjust the level.

The shelving function is always superimposed upon any graphic or parametric curve already existing in RAM. In other words, the relative levels of adjacent frequency bands are more-or-less maintained, while the overall slope is altered.

You can create curves with varying slopes, this is explained in **EQ SETUP** menu (see section 6.2.6). Having confirmed the edit with “**OK**”, the ULTRA-CURVE will leave the shelving mode, and return to the EDIT menu. By pressing “**CANCEL**” the settings made in the shelving menu will be cancelled, and you return to the EDIT menu.

▲ Channel Switching

In the EDIT menu, you can switch back and forth between the two channels, using softkey C. The pictogram for softkey C will show you which channel is active, and whether or not the channels are connected to each other via the STEREO LINK function.



▲ Comparison Functions

Softkey D “**A/B**” (A highlighted) or “**A/B**” (B highlighted) allows you to compare the current setting with the settings pertaining to the program as it was loaded.

“**A/B**” (A highlighted) denotes the program as it was on loading.

“**A/B**” (B highlighted) denotes the most recent setting.

If you are not satisfied with the new setting, you can return to “**A/B**” (A highlighted), and from there you can start again. Once you start to edit, the pictogram will change to “**A/B**” (B highlighted), immediately showing the new status of the program. Upon loading a new program, “**A/B**” (neither A nor B highlighted) will be shown, indicating the “not-yet-edited” status of the program.

6.2.6 EQ Setup

You can access the EQ SETUP menu by pressing the SETUP key. The EQ SETUP window appears in the display, and the LED above the SETUP key starts to blink.

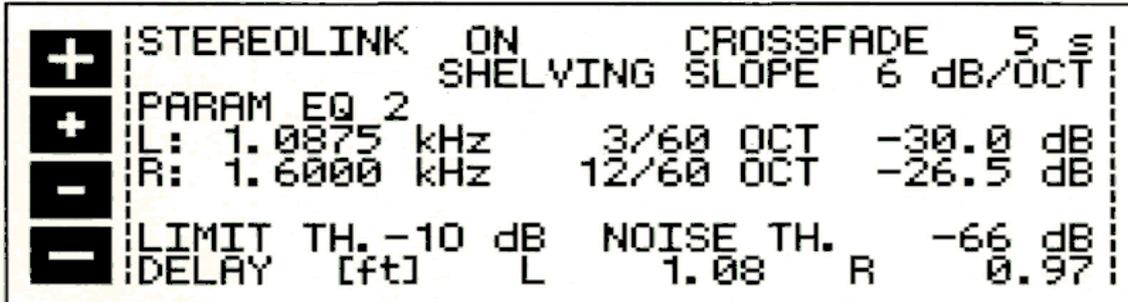


Fig.6.7: EQ SETUP window

You can use the cursor key to choose either the value or the condition to be changed. The active edit field will be highlighted by being displayed inverted. You can change status or value by using the softkeys marked +/- or +/- respectively.

STEREO LINK

ON The intelligent STEREO LINK function links the two channels, forming a stereo pair, in which all adjustments made have an equal, simultaneous effect on both channels. It is important to understand that this also applies when the two channels have different response curves set! The edits performed will make adjustments of equal value, independent of the original settings. For example: right channel, fader 4 was at +3, increasing 5 dB bring it to +8. Left channel, fader was at -4. It will be moved to +1 (in other words, the incremental changes are the same on both channels, but the absolute settings may still differ from each other). A further point to watch out for is the situation where a fader on one channel has been raised by a value which will take the corresponding fader on the other, linked channel above the maximum boost which the ULTRA-CURVE is capable of making, namely 16 dB. Because this is not possible, all the other faders will be automatically attenuated by the appropriate amount, and the master channel fader will be raised in compensation, in order to achieve the desired frequency response.

OFF switches off the channel link. The two channels can now be set fully independent of each other.

CROSSFADE

The CROSSFADE function causes a "soft" or gradual transition from one program when switching into another. This helps prevent any 'clicks' or other noises, which can be caused by very sudden changes to a program. The faders are seen to 'creep' to their new positions on the display. You may choose the time taken for this to occur, from 0 to 15 seconds being allowed. Please note that a setting of 0 seconds results in a 'hard' switch over, possibly causing the noises mentioned above.

SHELVING SLOPE

This is a tool which you can use to easily add High Pass, Low Pass and Bell-Shaped Response Curves to the Graphic Equalizer. The pictograms representing this tool are (see below #) (see section 6.2.5). The slopes of these curves can be adjusted, in 6 dB steps, from a slope of 6 to 30 dB per octave.

PARAM EQ

One of the three Parametric Equalizers can be selected in this field. The actual values will be shown in 6 fields (three per channel) and can be edited in these fields.

To the left you will find the frequency selection, which can be moved up or down in 1/60 octave steps (+/-), or in 1/3 octave steps (+/-) and which operates in the audio range from 20 Hz to 20 kHz.



In the middle the BANDWIDTH can be set, adjustable in 1/60 octave steps from the narrowest width of 1/60 octave up to 2 octaves as the widest possible setting. To the right is the LEVEL, adjustable in 0.5 dB steps from +16 to -48 dB. Above L = left channel. Below R = right channel.

Be careful boosting very narrow bandwidths! This can rapidly lead to audible distortion and, worse still, could cause damage to your loudspeakers - even before you hear the distortion!

LIMIT THRESHOLD

The ULTRA-CURVE has an integrated DIGITAL LIMITER to protect against overloading and resulting distortion. Its Attack Time is zero - in other words, it reacts 'in advance'. The operating Threshold of the LIMITER can be set, in 1 dB steps, anywhere from 0 dB down to -48 dB. The levels given in dB are relative to the maximum output signal (Dig Max) of the ULTRA-CURVE (0 dB Dig Max equates to +10 dBu or +8 dBV). Additionally, you can deactivate the LIMITER by choosing the setting OFF.

NOISE THRESHOLD

You can mute noise (e.g. from a mixing desk, or keyboards) which might appear during program pauses, by using the built-in NOISE GATE function. As soon as the signal level is lower than the Threshold you will have set, the ULTRA-CURVE'S outputs will be muted. The Threshold may be anywhere from -96 dB to -48 dB, the scale again referring to the digital maximum.

DELAY (OPTION)

The DELAY can be adjusted in 10 millisecond steps to a maximum value of 5 seconds, and this can be applied independently to each channel. An interesting alternative is to apply this as a measure of metres or feet per channel. The distances entered will be automatically calculated as time delays.

6.3 REAL TIME ANALYZER (RTA)

The integrated RTA in the Behringer ULTRA-CURVE allows audio spectral analysis with a 1/3 octave resolution to an accuracy of 0.25 dB. The associated display may be customized in a number of different ways to suit your preferred way of working. Press the RTA key to access the RTA mode.

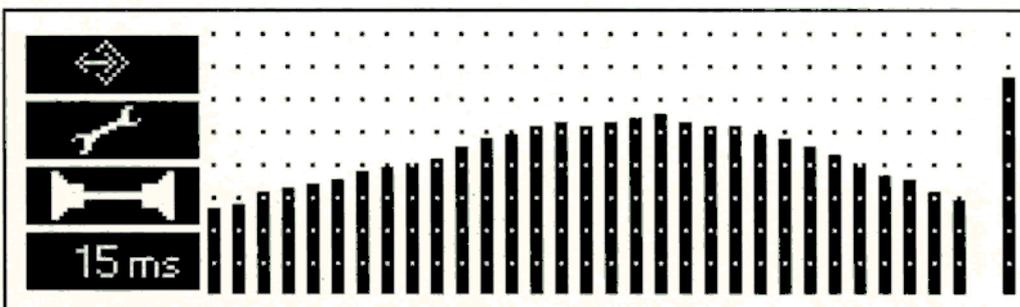


Fig. 6.8: Main RTA window

The RTA display shows the 31 1/3-octave frequencies, with the overall level to the right, similar in general to the equalizer display. To the left is the pictogram containing the softkeys. By moving the horizontal cursor keys or the one pointing upwards, you can 'freeze' the display, simultaneously displaying a set of crosshairs, and an information window (see figure on top of next page). Using the cursor key pointing downwards will make the crosshairs and the information window disappear as well as 'de-freeze' the display.

The information window displays the precise values pertaining to the selected frequency, along with the number of the RTA program currently in use. By moving the crosshairs to any given frequency band, or the overall level, you can display the details of the chosen band in the information window.

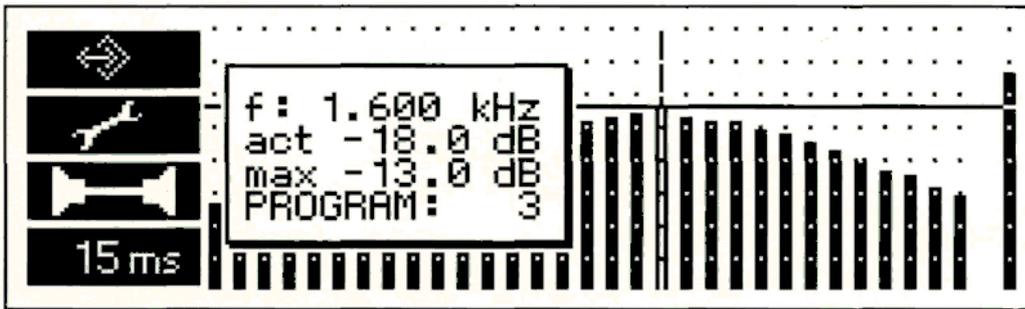


Fig. 6.9: RTA display with information window

f: the frequency in Hertz of the selected band,

act: the level present as the display was frozen,

max: the highest level reached on this frequency up to the point in time when the display was frozen (the maximum values stored in memory can be replaced).

The levels displayed in the RTA refer to the digital maximum.

PROGRAM: Shows the current RTA program number (1-10). In contrast to EQ programs, it is not possible to name RTA programs.

If after approx. 4 seconds, no cursor key is pressed, the information window will disappear. The display, however, remains frozen. By re-pressing the RTA key, you can return the ULTRA-CURVE to the normal, dynamic display.

6.3.1 Program Administration

By using softkey A (1) gain access to the sub-menus used for Program Administration.

A) Loading measurements

Softkey A (2) The information window appears in the display, and the measurement will simultaneously be displayed in the selected memory location. You can use the the vertical cursor key to select the 10 memory locations. In doing this, their current contents will be displayed. By using "OK" you load the stored measurement. The horizontal cursor may be used here to select individual bands, whose values will also be displayed. "CANCEL" stops the loading procedure. In either case, you will then be returned to the RTA menu. Press the RTA key once more when you wish to leave the stored display, and return to the current, dynamic display.

B) Storing measurements

Softkey B (3) Storing involves the same procedure as loading, you choose the memory location with the vertical cursor keys, confirm with "OK", cancel with "CANCEL". In contrast to the equalizer, memory locations already filled will be overwritten without further warning.

C) Transferring measurements to the equalizer

Softkey C (7) The measurement currently displayed will be transferred to the equalizer, but with ist values inverted (+5 becomes -5 etc.). This feature enables minor compensating settings to be easily made. By means of a sub-menu you can decide if you want the measurement to be transferred to the left, the right or both channels:

- (4) left channel,
- (5) right channel.
- (6) both channels.



6.3.2 Toolbox

Using softkey B , you can access the Toolbox menu.

With key A “**AUTO-Q**” you can start the ULTRA-CURVE automatic measurement sequence. You can choose, using a sub menu, whether to have the left, right, or both channels automatically measured:



left channel.



right channel.



both channels, that is, first one, then the other, and finally the sum of both channels will be measured and adjusted.

The AUTO-Q function: the ULTRA-CURVE automatic measurement procedure has several functions which are designed to prevent unusable settings from being made. For example, it will question whether a band has to be boosted by more than 12 dB to reach the desired frequency response. If this is the case, you may assume that the loudspeaker system being used is not capable of reproducing this frequency (typically if it is a very low or high frequency). The ULTRA-CURVE will therefore completely avoid the boosting of this frequency to any extent. This will avoid any overloading of the loudspeakers.

Please ensure that the current equalizer curve is in operation when you begin the measurement procedure. If you do this, you can influence the manner in which the automatic adjustment takes place. For example: If you lower the level of frequencies below 100 Hz before beginning to use AUTO-Q, it will result in these frequencies not having to be adjusted. On the other hand, boosting frequencies beforehand can result in them being automatically attenuated.

With key B  or  you can switch the Peak Level Indicator on and off.

With key C  you can re-set the Peak Hold display.

With key D “**M-GAIN**” or “**A-GAIN**” you can switch between manual and automatic level correction for the RTA display. The pictogram shows the current status. The A-GAIN function is very useful in providing an ideal display, avoiding having to continually adjust the sensitivity of the analyzer to various types of program material. Manual level correction may be carried out using the RTA-SETUP menu (see section 6.3.5).

Apart from performing their own function, use of the soft keys in the Toolbox menu returns the ULTRA-CURVE to the RTA menu.

6.3.3 Choosing a Source

With key C  you decide which signal is to be analyzed. The choices available are shown in the pictogram.



The left channel will be measured.



The right channel will be measured.



MONO, the two channels are summed, and then measured.



The signal at the Reference Microphone Input will be measured.

6.3.4 Decay

With key D “**65 ms**” you can set the DECAY time for measurements. Values of 15, 65, 250 and 1000 milliseconds (1.0 s) can be entered. The current value is shown in the pictogram. Please note that increasing the DECAY results in a slower display.

Short DECAYS are necessary to display fast processes, whereas using long DECAYS with static signals will result in a 'quieter' display, which is usually desirable for this type of signal.

6.3.5 RTA Setup

The RTA SETUP menu is opened by pressing the SETUP key. The RTA SETUP window appears in the display, and the LED above the SETUP key blinks.

+	SOURCE	MONO	DETECTOR	PEAK
	MAX DISPLAY	OFF	DECAY	15 ms
+	RESOLUTION	1.0 dB	AUTO-Q	CURVE FLAT
-	GAIN MODE	AUTO	RTA OUTPUT	WHITE
	LINE GAIN	+4. dB	SINE f	1.875 kHz
-	MIC GAIN	+28. dB	LEVEL	-12.0 dB
	MIC CORR	NONE		

Fig. 6.10: RTA SETUP window

You can use the cursor key to choose the parameters or values you wish to edit. The currently selected field is highlighted by inverting. You can change parameters or values with the softkeys marked “+/-” or “-/-” respectively.

SOURCE

This field is used, as is the case in the RTA menu to select the Signal Source for the analyzer. The display here reads as follows: MONO, RIGHT, LEFT, and MICRO, each referring to the sources available.

DETECTOR

Used to switch the measurement filter between Peak and RMS characteristics.

DECAY

Setting the DECAY: 15, 65, 250 or 1000 milliseconds per 20 dB.

MAX DISPLAY

ON = Peak Level Indicator ON, OFF = Peak Level Indicator OFF

RESOLUTION

You can use this field to set the resolution of the Graphic Display, choosing between 0.5 dB per pixel, or 1 dB per pixel. (A pixel is the smallest single point the display screen can generate).

When measuring a steady signal e.g. when using Pink Noise to adjust a loudspeaker system, the use of the finer resolution is recommended.

AUTO-Q CURVE

You can use one of the 100 stored equalizer settings as a target curve for the AUTO-Q function. The curve setting will then correspond to the fader positions of the program selected. (The target curves for each channel may differ from each other). If no program number has been given, "FLAT" will be displayed, meaning that an attempt will be made to achieve a linear response.

GAIN MODE

The ULTRA-CURVE analyzer is capable of setting itself dynamically to suit the input signal level. This frees you from adjusting the input level manually. In this AUTO mode, the gain levels selected by the ULTRA-CURVE will be shown in the respective LINE GAIN and MIC GAIN fields. The automatic adjustment can be switched off (MANUAL).

LINE GAIN

When operating in manual mode, the input amplification for the internal signal is displayed in this field. It can be adjusted, in 4 dB steps, from 0 to 60 dB. (This feature is solely used in RTA mode).

MIC GAIN

as above, for the Reference Microphone Input. Gain can be adjusted from 20 to 80 dB.

MIC CORR

You can use one of the stored EQ curves as a corrective curve for the analyzer measurement, to compensate for any frequency response variations caused by the Reference Microphone. In the field the chosen program position, and the chosen side (L/R) are displayed. NONE = no corrective curve. (Please refer to the recommendations in section 4.3.3.)



There are three fields in which you can choose which type of output signal from the ULTRA-CURVE digital generator you wish to use to make a measurement:

RTA OUTPUT

You can choose the type of output signal you need in this field: PINK = Pink Noise, WHITE = White Noise, SINE = Sine Wave, OFF = Signal Generator Off or INPUT = Input Signal.

WHITE NOISE is composed of multitudes of sine waves packed close together, of equal amplitude, whose phases are random compared to each other (statistically different from each other). Their 'density' or, spectral intensity is constant at any given frequency. With PINK NOISE, the spectral intensity is inversely proportional to the frequency. In other words, the intensity of White Noise is constant for an absolute bandwidth e.g. 50-100Hz, or 5000-5050 Hz whereas for Pink Noise, the intensity is constant over a relative bandwidth e.g. an octave (50-100Hz, 5000-10000 Hz). The difference between White and Pink Noise can be highlighted by the following example. By taking a situation where the intensity of both Pink and White Noise found between 20 and 40 Hz is arranged to be the same for both types of noise, it follows that, in the case of Pink Noise, the same intensity will be found between 10,000 and 20,000 Hz. both bandwidths being one octave. However, as the number of discrete frequencies between 10,000 and 20,000 Hz is five hundred times greater than between 20 and 40 Hz. it follows that the intensity of White Noise present between these two frequencies is correspondingly greater.

SINE f

You use this field to set the Frequency of the Sine Wave. It is adjustable in 1/60 octave steps from 20 Hz-20 kHz.

LEVEL

The Output Level can be adjusted in 1 dB steps from 0dB to -48 dB (with reference to the digital maximum).

The internal digital signal generator is routed into the outputs when you switch into RTA mode.

As a rule. Pink Noise is used for system measurement.

You must switch the ULTRA-CURVE to BYPASS, using the IN/OUT switch, if, when in RTA mode, you wish the input signal to be present at the outputs.

Use the RTA-lock function to prevent accidental signal interruption when using the ULTRA-CURVE for live purposes.

7.0 APPLICATIONS

The open mainframe architecture of the Behringer ULTRA-CURVE with its many audio processing features allows it to be used in a multitude of different ways. The following examples, with the appropriate ULTRA-CURVE settings relevant to each, will give you an idea of the versatility of the device.

7.1 USING THE ULTRA-CURVE AS A SUMMING EQ IN A P.A.

This will probably be the most common use for the ULTRA-CURVE.

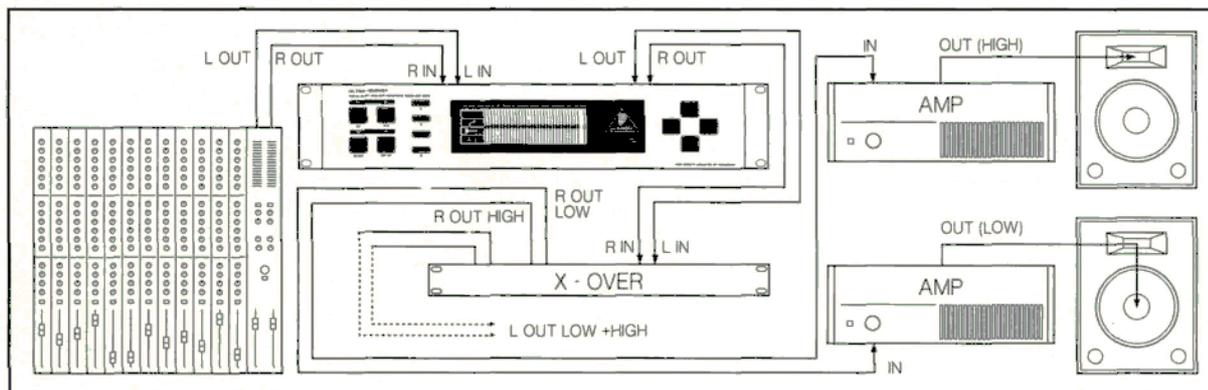


Fig. 7.1: The ULTRA-CURVE as a summing equalizer in a P.A.

To obtain the best results the following points should be paid close attention to.

Experience has shown that, before beginning to use the equalizer, it is sensible to listen to a variety of music and speech material with which you are thoroughly familiar, playing these references straight through the system without any corrective EQ. Should any form of distortion, or unwanted effect be noticed, it will most likely be due to overloading or signal mis-match within the system, which should first be corrected. The importance of loudspeaker positioning cannot be overemphasized! There is no equalizer available which can compensate for sound which is 'washed out', imprecise and unclear due to interference from walls or ceilings. You can achieve DRASTIC improvements in sound quality by careful re-positioning of your loudspeakers.

In the case of an active system with two, three or more loudspeakers served by a crossover you must pay particular attention to travel path time differences and phase coherence between the different components of the system. (The Behringer SUPER X crossover, with its variable crossover frequency settings, its phase reverse and electronic time path correction gives you all the tools required to carry out these corrections.)

Once the above points have been attended to, the ULTRA-CURVE may be put to work. By using the Automatic Measurement Procedure you will quickly get a usable basic EQ setting. Pay particular attention to the placement of the Reference Microphone. It should be placed in the direct radiation path of the loudspeaker system and may not be interfered with by anything causing a disturbance in the room acoustic. Placement behind curtains, less than 3 feet from side or rear walls, or on a balcony is to be avoided, as these positions inevitably exhibit a 'coloured', false acoustic. Background noise should be at least 6 dB (preferably 10 dB) below the nominal working level, otherwise it will influence the measurement to the extent that it cannot be relied upon to proceed with a workable system equalization.

Disturbances such as mains hum, or narrow band resonances may be effectively eliminated with the ULTRA-CURVE'S Parametric Filters. They should be dealt with before proceeding with a measurement. After the automatic measurement has been completed you have a basic set-up, which you should start to finely adjust manually.

Please note:

- ▲ A linear or 'flat' frequency response is not always the setting to go for. In the case of a system which will be used for speech purposes, the priority has to be ease of intelligibility, which requires that the bass response of the system should fall off. Anything below the fundamental frequency of speech will cause problems.

- ▲ Very low and high frequencies will usually be amplified (carried over) to a much lesser extent. There is no sense in driving a loudspeaker cabinet designed only for speech/vocal use hard at frequencies below 50 Hz. Apart from the increase in power required, this can also result in very expensive loudspeaker repairs. Always be aware of and work within the physical limitations of your system.
- ▲ If time allows make several measurements with the Reference Microphone in different positions. The figure below shows some suitable positions for taking measurements.

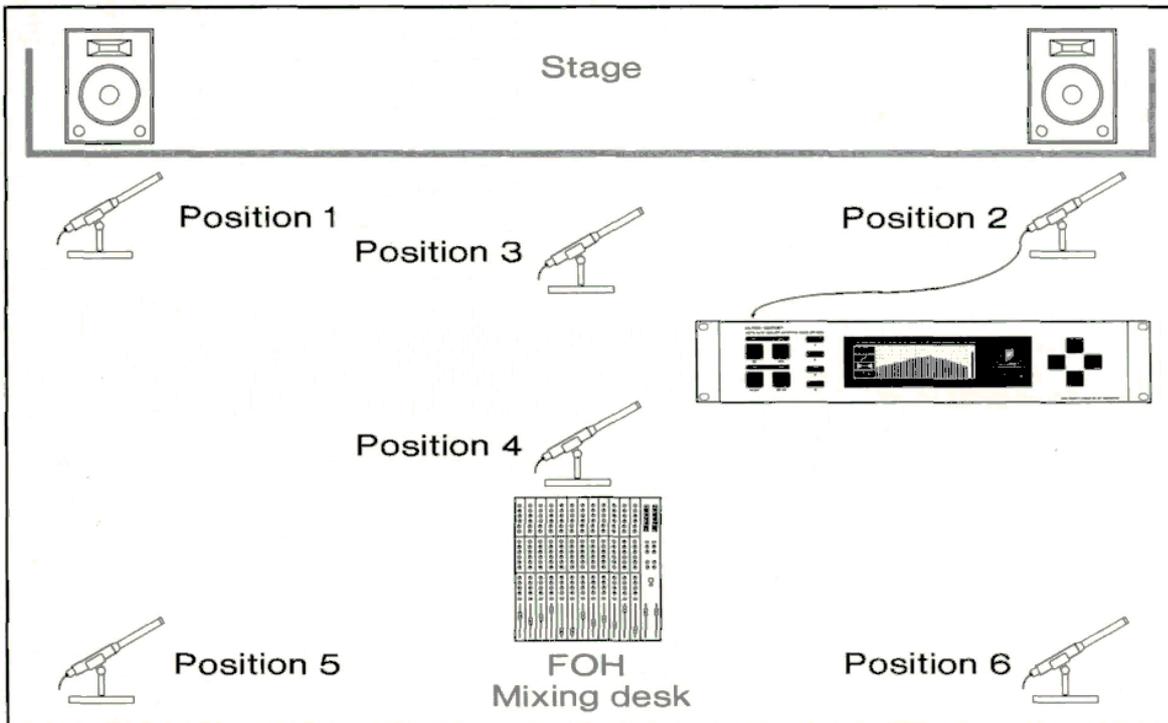


Fig. 7.2: Recommended positions for measurements with the Reference Microphone

Positions 1 and 2 are about three feet directly in front of the loudspeaker system, positioned halfway between the middle and high frequency components. These measurements can be used as a control of the basic system functions.

Position 3 is about seven feet in front of the stage centre. Measurements taken here should show an identical response above 250 Hz as obtained from positions 1 and 2. Due to the summing of both loudspeaker systems, the level below 250 Hz should be 3 dB higher.

Position 4 is some way back from position 3, directly in front of the FOH mixing position. (FOH means front of house). The measurements here should be the same as at position 3, with a lower level.

Positions 5 and 6 are on the axes of the two loudspeaker systems, three feet away from the rear wall. These measurements are used to detect any problems caused by standing waves or reflections.

- ▲ Make sure to save the resulting frequency response curves for comparison purposes. Any major differences between the various measurements should be interpreted as warnings of phase problems within the system or acoustical problems in the room. If you are not able to deal with the source of these problems (by moving speakers, or changing the venue), then you can only attempt to find a workable compromise with the equalizer. For this purpose, the various stored measurements will be of great assistance.
- ▲ After reaching the desired frequency settings on the equalizer, walk around the room and pay particular attention to any change in the sound as you move around. Don't forget to periodically listen to your reference music and spoken material to help 'refresh' your ears and particularly to get a more objective feeling for the characteristics and sound of your system and the room.

You must be prepared to invest plenty of time and patience to obtain an effective equalizer setting!

Beware of using extreme settings to achieve the sound you are looking for. They are inevitably a warning that something is wrong with your system.



An equalizer cannot compensate for a bad sound system, however it is a flexible and very useful tool for fine tuning sound. With practice you will see that subtle changes brought about with the equalizer can greatly enhance the ability of your system to deliver a clear, well defined sound, measurably improving its overall quality.

7.2 USING THE ULTRA-CURVE FOR MONITOR EQ PURPOSES

In using the ULTRA-CURVE in a monitor signal path, you should apply the ground rules discussed in the last section for RA. use. In addition, the ULTRA-CURVE has a number of features designed specifically to assist in monitor equalizing.

- ▲ The FEEDBACK DESTROYER enables you, during soundcheck, to locate and control any frequencies causing feedback problems. (In this case, having detected a problem frequency, you match the filter to the frequency by switching on "-" in the FB-D menu).
- ▲ In the case of microphones which are constantly moving (typically hand held vocal microphones) the feedback conditions are continuously changing. Use the FEEDBACK DESTROYER filter in searching mode ("S") to compensate for this.

The FEEDBACK DESTROYER is only suitable for use with signals with a large, changing dynamic (speech, singing, percussion). Long, static signals such as synthesizer or flute, whose sound characteristics have similarities to sine waves, cannot be distinguished from feedback, resulting in their signal being constantly dampened.

If, in "SEARCHING" mode, all the available filters are being used, in the case of a new frequency being found, the 'oldest' filter in use will be released from its set frequency and made available for the new one.

The FEEDBACK DESTROYER cannot work miracles! It is capable of raising the feedback threshold by only a few dBs. Seeing the FEEDBACK DESTROYER switching on should be interpreted as a warning signal. Lower the overall volume on stage.

In principle the stage volume really should be kept as low as possible, because:

- 1.) It is better for everybody's hearing!
- 2.) It results in fewer feedback problems.
- 3.) It is easier to get a good FOH sound.

The monitor level tends to rise during the course of a concert. Therefore you should use any pause in the concert to reduce all monitor levels by about 3 dB. This reduction will, if at all, be barely noticeable to the musicians - their hearing will recover sensitivity during a pause - the end result is that you recover valuable headroom.

- ▲ If you are repeatedly using the same monitor loudspeakers, you can save the EQ settings which you have set for these speakers (store them under names such as WEDGE 15" or DRUMFILL).
- ▲ Extremely low frequencies should be filtered out to avoid a 'muddy' stage sound.

TIP: Set the shelving tool  to give you a high pass filter. (Set the shelving slope in EQ SETUP to 30 dB.) By using the horizontal cursor keys you can easily change the cut-off frequency for the high pass filter, to enable you to rapidly tailor the monitor sound to suit the program being reproduced.

If you have a large system with a separate monitor mix and more than 4 independent monitor sub-mixes, we recommend the use of one ULTRA-CURVE solely as an analyzer. The figure on top of the following page gives an example for the use of several ULTRA-CURVES in a multiway monitor application.

The AFL output from the monitor mixing desk is normally used to feed a loudspeaker at the mixing position. You can feed this output through the analyzer line input. The ULTRA-CURVE will then switch its display from microphone to line, and the output signal from the AFL will be present at the line input to be analyzed.

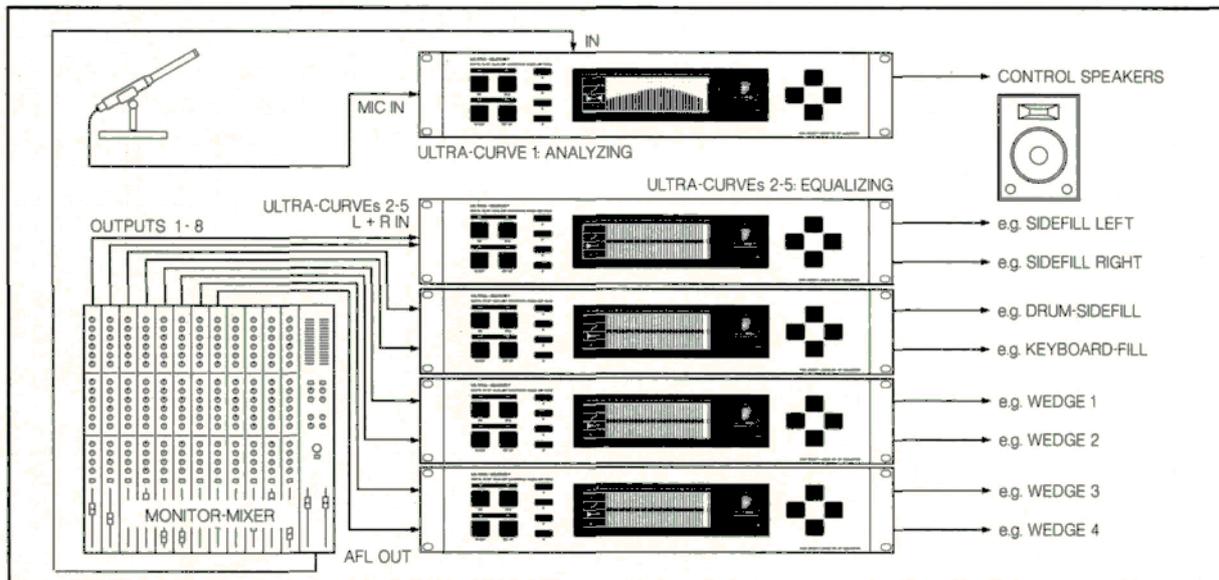


Fig. 7.3: Several ULTRA-CURVEs in a multiway monitor application

7.3 USING THE ULTRA-CURVE IN RECORDING STUDIO

There are countless uses for the ULTRA-CURVE in the studio. The only limits are those set by your own imagination. Here are a few examples:

- ▲ As the equalizer for the studio monitor system. In addition to the usual graphic EQ use, you can use the parametric filters to eliminate narrow band room resonances, standing waves etc.
- ▲ As mastering equalizer. By using the STEREO LINK function you need only set one channel of the equalizer to achieve the desired EQ setting. The parametric filters are also very useful for this purpose. By using the optional AES/EBU digital inputs and outputs you can treat material working solely in a digital environment.

The STEREO LINK function does not apply to the parametric filters!

- ▲ As a sound tool for any purpose. If you are working with a sequencer, you can program the equalizer, via MIDI, to give you a 'moving EQ' automation - you can control individual graphic faders, and store their movements per MIDI, enabling you to reproduce the EQ mix settings at any time.

7.4 THE ULTRA-CURVE AS PART OF A KEYBOARD SETUP

The MIDI features of the ULTRA-CURVE offer a wide variety of uses in a keyboard setup.

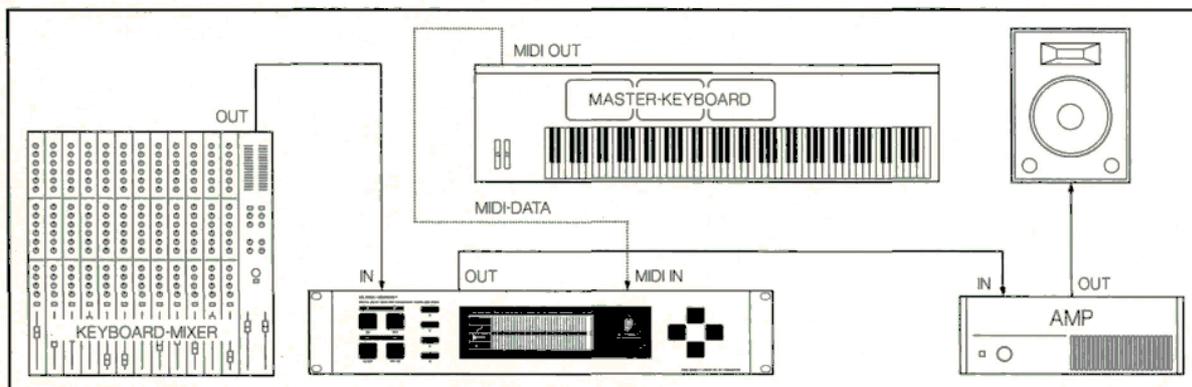


Fig. 7.4: The ULTRA-CURVE in a keyboard setup

You can improve your sounds with the equalizer using program change commands.

If you have a master keyboard with user-definable controllers, you could, for example, control the ULTRA-CURVE master faders (controllers 95 and 127).

7.5 THE ULTRA-CURVE IN A GUITAR SETUP

An important part of a guitar setup is frequently a MIDI footswitch, used to send program change commands to MIDI effect units, or a MIDI-controlled amplifier. You can integrate the ULTRA-CURVE into this set-up as an equalizer and gain-adjusting device (you can save the master-fader positions for each of your pre-sets).

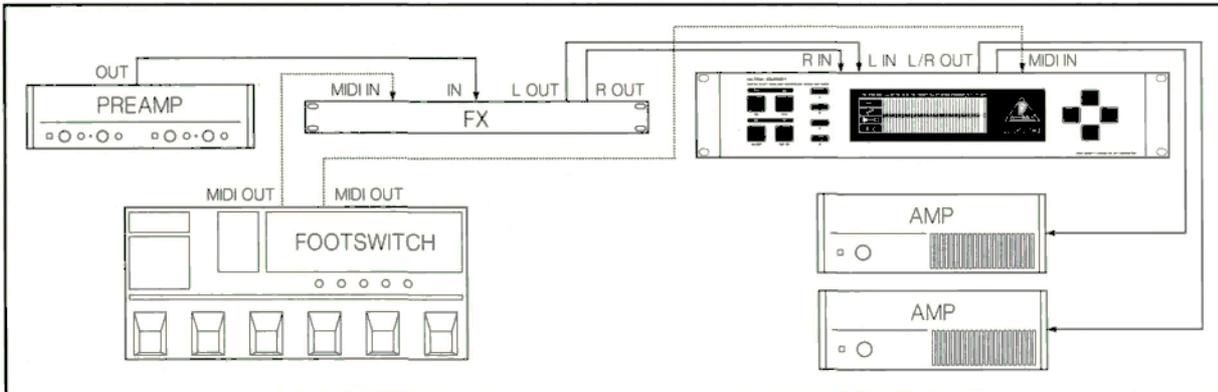


Fig. 7.5: The ULTRA-CURVE in a guitar setup

7.6 THE ULTRA-CURVE AS AN ADC (AES/EBU Option)

As the ULTRA-CURVE uses very high quality 20 bit ADCs (Analogue/Digital Converters), it is most suitable for use as an external analogue-to-digital converter in conjunction with a DAT recorder.

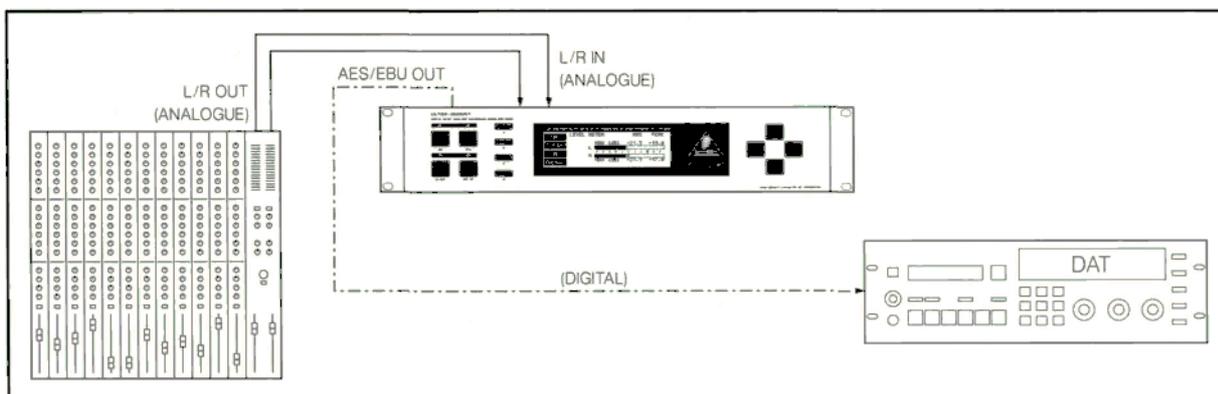


Fig. 7.6: The ULTRA-CURVE as an ADC

You can select a sampling rate in the SETUP menu (if you will use your mixdown for CD production purposes, select the 44.1 kHz sampling rate).

You can monitor the signal level in the LEVEL METER menu (Dig Max). Level changes should be made with the master fader, with STEREO LINK switched on.

7.7 THE ULTRA-CURVE AS A DELAY UNIT (DELAY Option)

In addition to the uses described in section 7.1, it is often the case in a large installation, that loudspeaker systems are placed a considerable distance away from the stage, or are suspended at a height (flown), in order to give those sections of the audience further away from the stage the same clear, direct sound as those with better positions.

In order to compensate for the time differences existing between the main L and R loudspeakers and those further away, the signal to the latter will be sent through an electronic delay device, normally a separate unit designated solely for this purpose.

The ULTRA-CURVE removes the necessity of having to use a separate delay unit, as it can produce a signal DELAY for the material it is processing. This operates just as comfortably and effectively as having a dedicated delay unit.

The Delay settings can be stored with the program.

If several groups of identical loudspeakers are being used, each having a different Delay time, they can be controlled by a multiple ULTRA-CURVE system, interconnected via the optional AES/EBU digital interfaces, thus avoiding any signal deterioration.

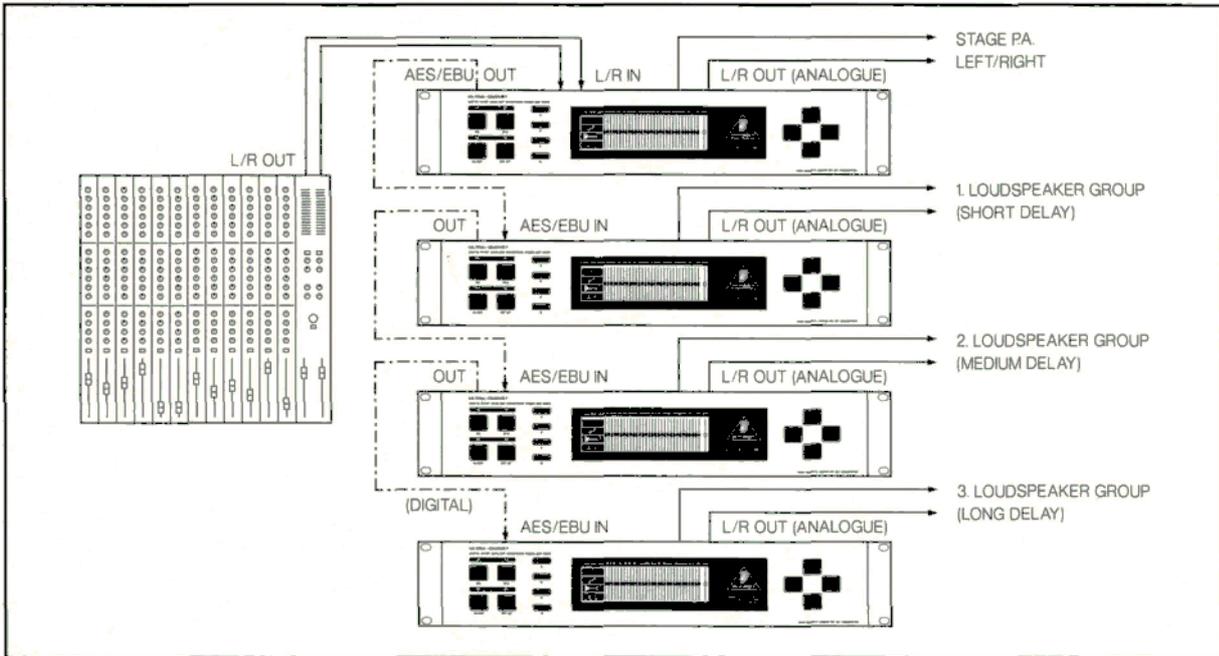


Fig. 7.7: Several ULTRA-CURVEs in an 'advanced' Delay application

If we assume, for the purposes of this example, that the same type of loudspeakers are being used in the various locations, under similar acoustic conditions (e.g. open air), then we can operate the system as follows:

- ▲ The first ULTRA-CURVE in the chain will be set up as in section 7.1, operating here as the signal source.
- ▲ The second ULTRA-CURVE provides the equalization for all successive loudspeakers, the EQ settings can be used to compensate for the difference between the equalization of the stage L and R speakers and the remote loudspeaker groups. The Delay setting corresponds to the time difference between the main L and R loudspeakers and the first loudspeaker group.
- ▲ The third ULTRA-CURVE receives an equalized, delayed signal, therefore requiring only a further Delay to allow for the time difference between loudspeaker groups 1. and 2. Fine adjustments with the equalizer may, of course, also be made.
- ▲ The same applies to ULTRA-CURVE No. 4, the Delay time in this case allowing for the time difference between loudspeaker groups 2 and 3.

This method of digitally 'chaining' the ULTRA-CURVEs through AES/EBU can only work when using the same type of loudspeakers, or at least when a minimum of equalization will be carried out by the ULTRA-CURVEs placed after the first one in the chain. The reason for this is that despite the maintenance of signal quality afforded by digital signal processing and transfer, by linking several digital filters in series with each other, the quantize noise from each device will be summed, which can result in it becoming an audible noise problem. This noise will not arise when a series of DELAYS are linked together as no processing takes place, instead the signal is merely stored briefly in each unit.

If equalizer settings are required which differ substantially from each other, it is recommended to link the units in parallel to each other, either via analogue, or using an AES/EBU signal distributor

8.0 SPECIFICATIONS

Analogue Audio Inputs

Type	Servo-Balanced Input
Impedance	40 kOhms
Nominal Operating Level	-10 dBV to +4 dBu
Max. Input Level	+21 dBu balanced and unbalanced

Analogue Audio Outputs

Type	DC-Decoupled, Servo-Balanced Output Stage Automatic Level Correction for unbalanced use (correction: 6 dB)
Impedance	40 Ohms, balanced and unbalanced
Max. Output Level	+16 dBu balanced and unbalanced
Bandwidth	20 Hz to 20 kHz (+0, -0.5 dB)
THD+N • 1 kHz / +10 dBu	0.004 %
Signal to Noise Ratio • 1 kHz / +10 dBu	104 dB
Crosstalk • 1 kHz	80 dB

Bypass

Type	Relay-Controlled Bypass
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Reference Microphone Input

Type	Servo-Balanced Input
Impedance	2 kOhms
Nominal Operating Level	-60 dBu to 0 dBu
Max Input Level	+1dBu
Phantom Power	+15 V

Digital Audio Input (Option)

Type	AES / EBU Transformer-Balanced
Impedance	10 kOhms balanced
Nominal Input Level	3-10 V peak-to-peak

Digital Audio Output (Option)

Type	AES / EBU Transformer-Balanced
Impedance	100 Ohms balanced
Output Level	5 V peak-to-peak

MIDI Interface

Type	5-Pin DIN-Socket In / Out / Thru
Implementation	Refer to MIDI Implementation Chart on page 8-5

Digital Processing

Converters	20-bit Sigma-Delta
Sampling Rate	48 kHz, 44.1 kHz, 32 kHz

Graphic Equalizer (GEQ)

Type	Digital 1/3 octave Equalizer
Frequency Range	31 filters on ISO center frequencies, from 20 Hz to 20 kHz
Bandwidth	AUTO-Q, variable, gain-dependent
Boost / Attenuation	Variable from +16 to -16 dB in steps of 0.5 dB (True Response)

Parametric Equalizer (PEQ)

Type	3 independent filters per channel
Frequency range	20 Hz to 20 kHz, adjustable in steps of 1/60 octave
Bandwidth	1/60 to 2 octaves, adjustable in steps of 1/60 octave
Gain	Variable from +16 to -48 dB in steps of 0.5 dB

Feedback Destroyer (FB D)

Type Filter	DSP-controlled Digital Signal Analysis 3 independent, digital Notch Filters per channel, user selectable as fixed or dynamic filters for automatic Feedback Suppression
Frequency Range	20 Hz - 20 kHz, adjustable in steps of 1/60 octave
Bandwidth	2/60 to 12/60 octaves, depending on the characteristic of the feedback
Attenuation	Up to -48 dB, depending on the gain of the feedback
Time required to eliminate feedback	0.6 sec, typical at 1 kHz

Digital Delay (Option)

Type	Digital Stereo Delay
Maximum Delay Time	5 sec, independently adjustable for each channel
Minimum resolution	0,1 msec
Delay unit	Seconds, metres or feet

Level Meter

Type	Digital Level Meter with simultaneous graphical display of Peak and RMS values
Attack / Decay (RMS)	50 msec / 20 dB
Attack (Peak)	0.1 msec
Decay (Peak)	1 sec / 20 dB

Noise Gate

Type	Digital IRC (Interactive Ratio Control)
Threshold	Variable from -48 to -114 dB in steps of 1 dB
Attack / Release	Processor controlled, program dependent

Limiter

Type	Digital IGC (Interactive Gain Control)
Threshold	Variable from 0 to -36 dB in steps of 1 dB
Release	10 dB / sec

Real Time Analyzer (RTA)

Type	Digital 1/3 octave Analyzer
Frequency Range	31 filters on ISO center frequencies, from 20 Hz to 20 kHz
Detectors	Peak or RMS
Decay	Variable 1 sec, 250 msec, 65 msec or 15 msec (per 20 dB)
Sine Wave Generator	Frequency adjustable from 20 Hz to 20 kHz in steps of 1/60 octave Gain adjustable from 0 to -48 dB in steps of 0.5 dB
Noise Generator	White or Pink characteristic Gain adjustable from 0 to -48 dB in steps of 0.5 dB

Display

Type	240 x 64 dot matrix. Liquid Crystal Display (LCD)
Backlight	LED Array
Contrast	adjustable

Memory

EQ Programs	100 memory locations, capable of storing all relevant settings for GEQ, PEQ, FB-D, and DELAY in addition to a program name with a maximum of 12 characters
RTA Measurements	10 memory locations
Password Protection	2 levels, memory protect or security lock, both protected with a alphanumerical 12 digit password

Power Supply

Mains Voltages	100-120 / 200-240 VAC 50-60 Hz
Power Consumption	40 Watts
Fuse	315 mA (100-120 V); 160 mA (200-240 V) slow-blow
Mains Connection	Standard IEC receptacle
Battery	Lithium CR 2025, 3 V 130 mAh
Battery Life	3 years, typical

Physical

Dimensions (H * W * D)	3-1/2" (89 mm) * 19" (482.6 mm) * 12" (304.8 mm)
Net weight	5kg
Shipping weight	6.6kg

Behringer Spezielle Studioteknik GmbH is constantly striving to maintain the highest professional standards. As a result of these efforts, modifications may be made from time to time to existing products without prior notice. Specifications and appearance may differ from those listed or shown.

8.1 OPTIONS AND DEVELOPMENTS

8.1.1 Options

The following options will be available for the ULTRA-CURVE:

DELAY 8000

Contains the Delay functions. It consists of RAM memory chips, as well as operating software (EPROM).

AES 8000

The digital AES/EBU Input and Output. Consists of an additional circuit board with the driver software for the AES/EBU connections, the XLR connectors and balancing transformers, plus an update for the operating software.

Both options may be installed simultaneously.

You have the choice of ordering the options with the purchase of your ULTRA-CURVE, or adding them at a later stage. To do this, send your ULTRA-CURVE postage paid to the address mentioned in chapter 9.

Return your ULTRA-CURVE to us for the installation, otherwise you will invalidate your warranty.

8.1.2 Operating Software

The ULTRA-CURVE operating software is under continuous development to improve its performance and control, and to keep pace with your expectations and requirements. Therefore you are asked to contact us with your needs, suggestions and ideas. We will make every effort to put your ideas into use in successive software updates. In order to receive a new software update, you must send your ULTRA-CURVE to the above address. Information about new software versions will be available through music magazines, from your dealer or directly from Behringer Spezielle Studioteknik GmbH Phone +49 / 2154 / 9206-0

The current software version will always be displayed shortly after switching the ULTRA-CURVE on (below right edge of the display).

You will automatically receive the latest software when you order the "DELAY 8000" or "AES 8000" options.

8.1.3 Changing the Memory Protect Battery

The battery which maintains the program memory when power is switched off has a life of several years, depending on the frequency and duration of use. When the battery starts to run out you will see the message:

WARNING: BATTERY LOW

You should send the unit back to us as quickly as possible. We are able to replace the battery without losing the programs stored in the memory

If you fail to heed the warning to replace the battery the display will show the message:

BATTERY EMPTY: MEMORY CLEARED.

If this happens, you will have lost all your programs. Furthermore, new programs will also be lost once the ULTRA-CURVE is switched off.

8.1.4 Under Development

- ▲ A software program to run on a PC designed to control one or more ULTRA-CURVEs via MIDI, with extra functions and improved ease of use. The software will require an IBM compatible PC with a MIDI interface, together with a new operating software with extended MIDI functions for the ULTRA-CURVE(s).
- ▲ A development of the ULTRA-CURVE system software to allow master-slave control via MIDI.

8.2 MIDI IMPLEMENTATION CHART OF THE ULTRA-CURVE

<i>Function</i>		<i>Transmitted</i>	<i>Recognized</i>	<i>Remarks</i>
Basic Channel	Default	X	1-16	memorized
	Changed	X	1-16	
Mode	Default	X	1, 2, 3, 4	
	Messages	X	X	
	Altered	X	X	
Note Number	True Voice	X	X	
Velocity	Note ON	X	X	
	Note OFF	X	X	
After Touch	Key's	X	X	
	Chs	X	X	
Pitch Bender		X	X	
Control	64 – 94	X	0	Equalizer Left
	95	X	0	Master Level Left
	96 –126	X	0	Equalizer Right
	127	X	0	Master Level Right
Progr. Change	True [#]	X	0 (0 - 99)	
		X	1-100	
System Exclusive		X	X	
System Common	Song Pos	X	X	
	SongSel	X	X	
Tune		X	X	
System Real Time	Clock Commands	X	X	
Aux Messages	Local ON/OFF	X	X	
	All notes OFF	X	X	
Messages	Active Sense	X	X	
	Reset	X	X	
Notes				

Mode 1: OMNI ON, POLY
 Mode 2: OMNI ON, MONO
 Mode 3: OMNI OFF, POLY
 Mode 4: OMNI OFF, MONO
 0 = YES, X = NO

9.0 WARRANTY



§ 1 WARRANTY REGISTRATION

Warranty Registration must be completed and returned to Behringer GmbH within 8 days from the date of purchase.

§ 2 WARRANTY

Behringer GmbH warrants the materials, workmanship and proper operation of this Behringer product for a period of 12 months from the original date of purchase. If any defects are found in the materials or workmanship, or if the product fails to function properly within the specified warranty period, Behringer GmbH will repair or replace the product, at its discretion.

§ 3 RETURN AUTHORIZATION NUMBER (RA)

1. To obtain factory service call Behringer GmbH for a Return Authorization Number. RA numbers are necessary for proper tracking of your product. Call:

Tel. (0) 21 54 / 92 06 - 0 (10 am to 5 pm weekdays (MET))

2. The product must be returned in its original shipping carton, freight prepaid to:

BEHRINGER Spezielle Studiotechnik GmbH

Hanns-Martin-Schleyer-Str. 36-38,

FRG-47877 Willich/Munchheide II

Federal Republic of Germany

§ 4 WARRANTY AUTHORITY

Behringer GmbH reserves the right to inspect any products which may be the subject of any warranty claim before repair or replacement is carried out.

Behringer GmbH may, at its discretion, require proof of the original date of purchase (dated copy of original retail dealer's invoice). Final determination of warranty coverage lies solely with Behringer GmbH. Any Behringer product deemed eligible for repair or replacement under the terms of this warranty will be repaired or replaced within 30 days of receipt of the product at Behringer's factory. Products which do not meet the terms of this warranty will be repaired and returned C.O.D. with an invoice for labour, materials, return freight and insurance. Products repaired under warranty will be returned freight prepaid by Behringer GmbH, to any location within the boundaries of the Federal Republic of Germany. Outside of Germany, products will be returned freight collect.

§ 5 WARRANTY TRANSFERABILITY

This warranty is extended to the original purchaser, but it is not transferable to anyone who may subsequently purchase this product.

§ 6 LIMITATION OF LIABILITY

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